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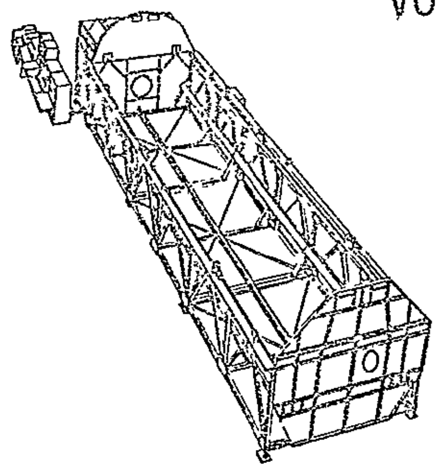

SHUTTLE PAYLOAD INTERFACE VERIFICATION EQUIPMENT STUDY
VOLUME III SPECIFICATION DATA

APRIL 1976

NASA CONTRACT: NAS9-14000 CCA 140 REV. 1

PREPARED BY:
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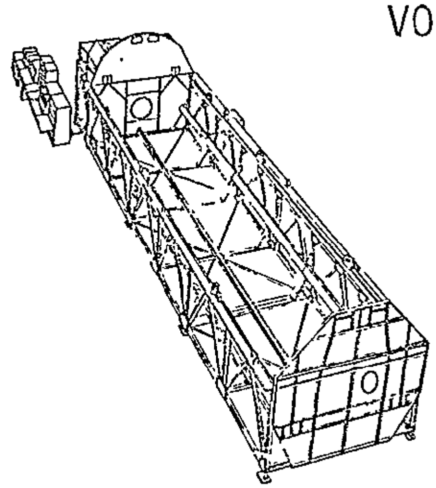

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FOREWORD

This document is a contractual requirement of NAS9-14000, CCA 140 Revision 1 and is provided in response to the contract. The study was conducted by the Space Division of Rockwell International for the Johnson Space Center of the National Aeronautics and Space Administration. It is published in four volumes:

Vol. I	Executive Summary
Vol. II	Technical Document - Part 1 Technical Appendices - Part 2
Vol. III	Specification Data
Vol. IV	Project Plans

TECHNICAL REPORT INDEX/ABSTRACT

ACCESSION NUMBER	DOCUMENT SECURITY CLASSIFICATION
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TITLE OF DOCUMENT	LIBRARY USE ONLY
Shuttle Payload Interface Verification Equipment(IVE) Study	
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DESCRIPTIVE TERMS

Shuttle	Preliminary Design	Data Management
Payloads	Operators Console	Computer
Spacelab	Mission Station	Heat Exchanger
P/L Interface	On-Orbit Station	Development Plans
P/L Interface Verif.	Payload Station	Schedules
Avionics	Electrical Power	
Payload Integration	Communications	

ABSTRACT

Single and mixed payloads must be integrated into the Shuttle Orbiter within the 160 hour turnaround requirement for the Shuttle system. In order to accomplish this integration process some off-line integration capability is required. This report is a preliminary design analysis of a "stand alone" (no facility GSE support required) payload integration device (IVE) capable of verifying payload compatibility in form, fit and function with the Shuttle Orbiter prior to on-line payload/Orbiter operations. The IVE is a high fidelity replica of the Orbiter payload accommodations capable of supporting payload functional checkout and mission simulation. A top level payload integration analysis developed detailed functional flow block diagrams of the payload integration process for the broad spectrum of P/L's and identified degree of Orbiter data required by the payload user and potential applications of the IVE.

This work was performed for Johnson Space Center of the National Aeronautics and Space Administration under contract NAS9-14000 CCA 140 Rev. 1.

SUMMARY

This volume contains a complete description of the IVE physical and performance design requirements as evolved in this study. The data is presented in a format to facilitate the development of an item specification. Data was used to support the development of the project plan data (schedules, cost, etc.) contained in Volume IV of this report.

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ILLUSTRATIONS

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TABLES

1.0 SCOPE

1.1 SCOPE

These sepcification data establish the performance, design and verification requirements for the development of the Interface Verification Equipment referred to herein as the IVE. IVE provides simulation of all physical and functional interfaces between the Orbiter and a payload. The IVE consists of a Standard IVE (Figure 1-1) and optional equipment permitting the tailoring of the IVE configuration to a specific payload user needs (Figure 1-2).

1.2 USE OF COMMERCIAL EQUIPMENT

Commercially available equipment which satisfies the functional, safety and reliability requirements of the IVE should be used to the maximum extent possible.

2.0 APPLICABLE DOCUMENTS

2.1 APPLICABILITY

The following documents of the exact issue shown, form a part of this specification to the extent specified herein. In the event of a conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall take precedence.

SPECIFICATIONS

Rockwell International/Space Division

MA0110 301B 12 February 1973	Product Cleanliness Requirements
MC409-0005 22 November 1974	Audio Distribution System
MC409-0006	Recorder, Magnetic Tape, Wideband Digital/Analog
MC476-0138 19 July 1974	Processor, Payload Signal
MC476-0136 10 May 1974	Interleaver, Payload Data

Rockwell International/Space Division

MC478-0106, Appendix VI 1 July 1975	Equipment, S-Band Network Processor, FM Signal
MC409-0025 1 February 1976	Processor, Ku-Band, Signal
MC409-0012 13 September 1974	Caution and Warning Electronic Unit and Status Display
MC615-0004 7 July 1975	Multiplexer/Demultiplexer
MC456-0051 30 July 1974	Master Timing Unit
MC476-0130 16 June 1975	Master Unit - Pulse Code Modulation

Standards

Federal

FED-STD-595a(1) 2 January 1968	Colors
MIL-E-4158E 11 January 1973	Electronic Equipment, Ground: General Requirements for

Military

MIL-STD-12C(2) 1 February 1971	Abbreviations, for use on drawings, specifications, standards and in technical documents.
MIL-STD-129F(1) 20 May 1974	Marking for shipment and storage
MIL-STD-130D(3) 1 August 1973	Identification Marking of U. S. Military Property
MIL-STD-794D(1) 25 May 1973	Parts and equipment, procedures for packaging and packing of

Military (Cont)

MIL-STD-1472A 15 May 1970	Human engineering design criteria for military systems, equipment and facilities
NS 33586B 25 September 1969	Metals definition of and protection for, dissimilar

NASA

JSC 07700 Vol. XIV	Space Shuttle Payloads Accommodation Document
MSFC 68 M00040.	Spacelab Specification performance, design and verification requirements for the Shuttle Interface Verification Equipment, Dec. 4, 1974 and revisions.
SE-S-0073A 22 May 1974	Specification, Space Shuttle Fluid, Procurement and Use of
KSC-F-124A 30 July 1968	Specification for Fittings ((Pressure Connections) Flared Tube
SW-E-0002	Space Shuttle Ground Support Equipment General Design requirements (as implemented by Rockwell International/Space Division in document SD74-SH-0250 "Implementation Report of the Space Shuttle Ground Support Equipment General Requirements").

Industry

Other publications	Appendix I Spacelab Functional Interface Verification Equipment Preliminary System Subsystem Specification, June 23, 1975
HSB8060.1	Flammability, Odor and Off Gassing Requirements and Test Procedures for Materials in Environments that Combustion

Handbooks

DoD H 4-1	Federal supply code of manufacturers
Latest Issue	Name and Code
OSHA	Occupational Safety and Health Act
ASME 1971	Boiler and Pressure Vessel Code - Section IV
NFPA No. 70 1971	National Electrical Code
AWS-D1.1	American Welding Society

Regulations

IRIG-10-73	Telemetry Standards, Telemetry Working Group Inter-Range Inst Group Range Commanders Council

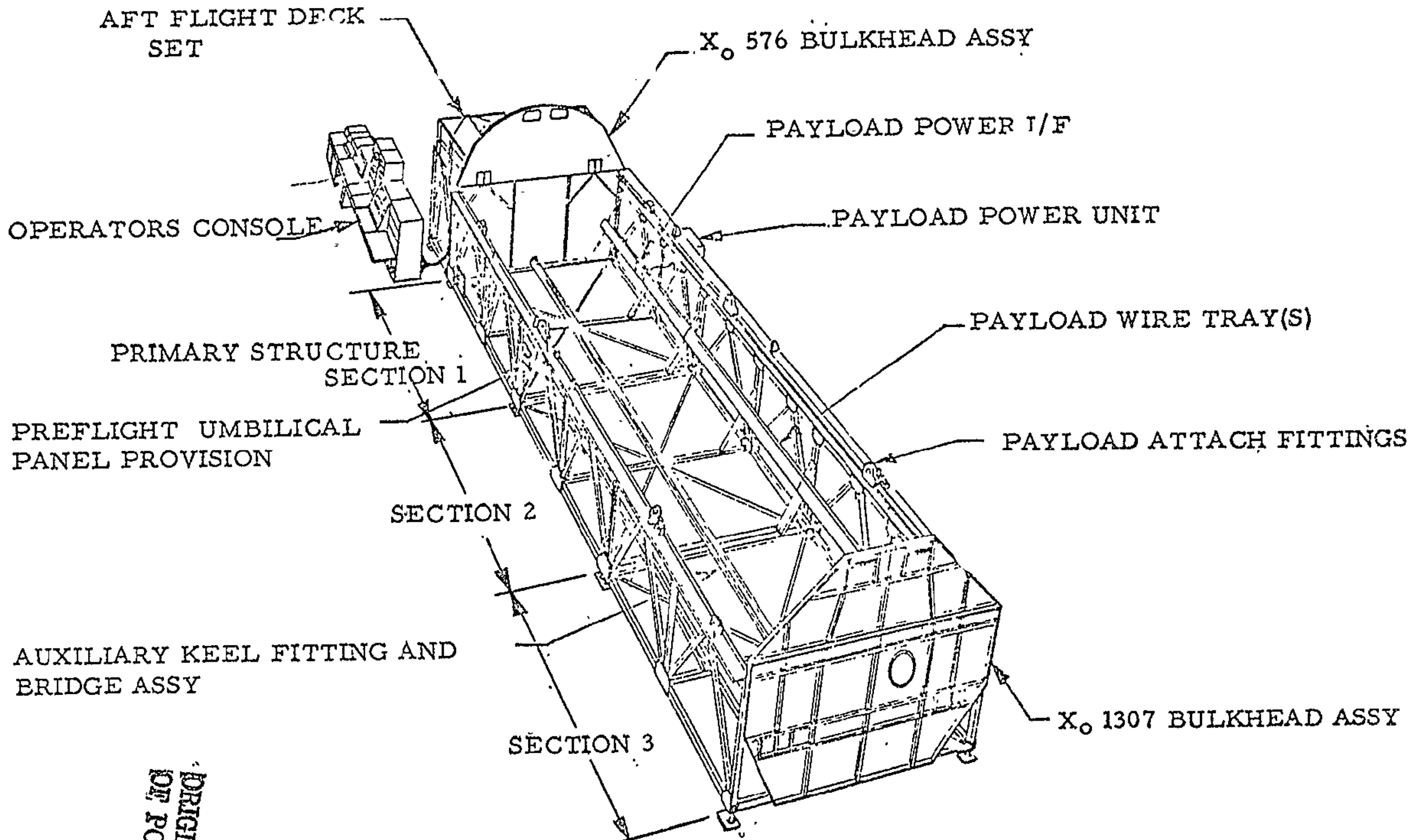

FIGURE 1-1 STANDARD HORIZONTAL IVE CONCEPT

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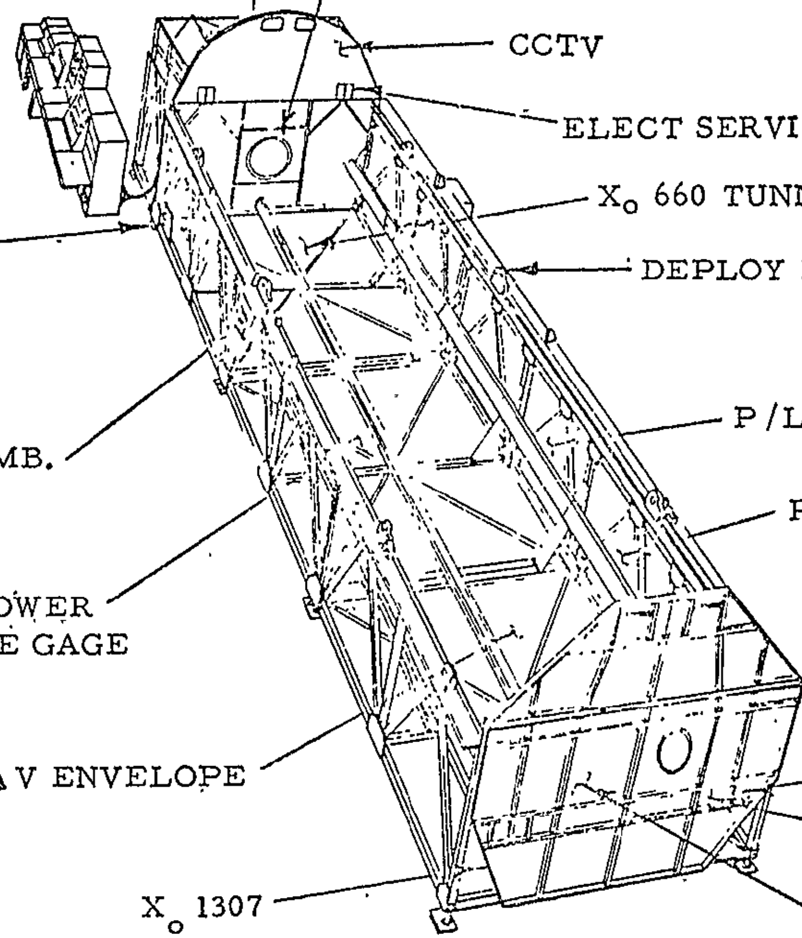

FIGURE 1-2 IVE OPTIONAL EQUIPMENT

3.0 REQUIREMENTS, GENERAL

3.1 EQUIPMENT, INTERFACE VERIFICATION

The interface verification equipment hereafter referred to as the "IVE" consists of those units required to provide verification of mechanical, electrical and fluid interfaces between the Orbiter and payload subsystems. The following paragraphs provide detailed information on the IVE component parts.

3.1.1 Structures and Mechanisms

Refer to paragraph 7.0, Standard IVE Structure and Mechanisms for Applicable Requirements.

3.1.2 Electrical Subsystems

Refer to paragraph 8.0, Standard IVE for Electrical Subsystems for Applicable Requirements.

3.1.2.1 Software

Refer to paragraph 8.6 for applicable requirements.

3.1.3 Fluids

Refer to paragraph 9.0, Standard IVE Fluids for Applicable requirements.

3.1.4 Optional Equipment

Refer to paragraph 10.0 for applicable requirements.

3.2 PHYSICAL CHARACTERISTICS

3.2.1 Deleted.

3.2.2 Deleted.

3.2.2.1 Weight.

The weight of the IVE shall not exceed TBD.

3.2.2.2 Hoisting, Lifting and Handling

The IVE shall have hoisting, lifting, and handling provisions as applicable.

3.2.2.3 Power and Grounding

3.2.2.3.1 Grounding Studs. The grounding studs location TBD.

3.2.2.3.2 Electrical Power Panel. The facility ac electrical power input connector location TBD.

3.2.2.4 Duty Cycle. TBD.

3.2.3 <u>Mode Controls</u>

3.2.3.1 Failsafe.

The IVE shall be designed to sustain a single failure without damage to other hardware, or injury to personnel.

3.2.3.2 Failure Propagation

The IVE shall be designed such that failures do not propagate sequentially into interfacing or associated equipment.

3.2.3.3 Redundant System Checks.

Where the IVE incorporates redundancies or failsafe protective devices, provisions shall exist to verify satisfactory operation of each redundent path and failsafe device.

3.2.4 <u>Maintainability</u>

3.2.4.1 Accessibility

The IVE design shall permit ready access for servicing, removal and replacement, calibration and inspection of interior components.

3.2.4.2 Fault Isolation

Fault isolation shall be limited to performing trouble shooting by use of auxiliary test equipment and testing at appropriate test points of the IVE.

3.2.4.3 Calibration

The IVE electrical/mechanical system shall interface with external

gaging and calibration equipment to facilitate calibration of electrical and mechanical equipment.

3.2.4.4 Special Tools

The IVE shall be designed to preclude the use of special tools and equipment for on-site maintenance and repairs.

3.2.5 Environments

3.2.5.1 Transportation and Storage

The The IVE shall be protected from the environments specified in MIL-STD-794 by adequate packaging or protective processes unless the design to operating requirements precludes the need.

3.2.5.2 Operational Environment

a. Temperature

	Sheltered and controlled	Plus 60°F to 80°F with extremes of uncontrolled of plus 52°F to 105°F for one hour.
b.	Ozone	3 to 6 parts per hundred million (phm) (at sea level).
c.	Pressure	Maximum of 15.23 psia (sea level)

d. Humidity

	Sheltered and controlled	Relative humidity 60 plus 10, minus 15 percent at 70 plus or minus 10 F

3.2.6 Transportability

The IVE shall be designed to be handled and transported to using facilities without damage or degradation, utilizing available methods of transport with the item prepared for shipment in accordance with Section 5 requirements. The equipment shall be compatible with the planned packaging and transportation system to the extent that loads induced in the equipment during transportation will not produce excessive stresses, internal loads or deflections resulting in damage to the equipment.

3.2.6.1 Weight and Size Limitations

The weight and size of the IVE as disassembled and packaged for shipment shall be such that individual packages will not exceed the following:

Width	120 inches
Height	81 inches
Length	264 inches
Weight	11,000 pounds

If impractical to design within the above limitations, the specific mode of transport, carrier vehicle, and transport route shall be established for the shipment; limitations associated with this planned shipment method shall then govern the design of the item.

3.2.6.2 Disassembly

The IVE, if requiring disassembly for shipment, shall be designed to facilitate disassembly and reassembly.

3.2.6.3 Tiedown Capability

The IVE design shall incorporate structural provisions adequate to permit the hardware to be secured to the transport vehicle, device or container by bolting, blocking, strapping, or other suitable means.

3.2.6.4 Integral Protective Capability

The IVE design shall incorporate one or more of the following provision for protection of components which are highly vulnerable to damage during transport and associated handling:

a. Wherever possible, external protection shall be used in lieu of design provisions.

b. Provide attach points for installation of temporary protective device(s) (covers, reinforcing structure, desiccant cartridge, air breather/filter, heater, etc.).

c. Make provisions for removal of sensitive component(s) for separate shipment.

d. Where external protection is not practical, provide "built-in" protective device(s) (e.g., cover, caging of free-moving components, desiccant chamber, heater, etc.).

3.2.7 Safety

3.2.7.1 Personnel Protection

The design of the IVE shall ensure that personnel are to be protected from all exposed sources of potential electrical shock (including tool contact) by means of appropriate guards, screens or barriers.

3.2.7.2 Protective Devices

The IVE shall contain either fuses, or circuit breakers or both, to prevent damage to internal equipment hardware, and to interfacing systems and equipment, and to prevent injury to operating personnel.

3.2.7.3 Safety Factors

Factors of safety and load factors applying to IVE shall conform to the following constraints:

a. General Structure. Safety and load factors for general structures shall be consistent with the intended use and they shall conform to the Occupational Safety and Health Act (OSHA) standards. Mechanical properties of materials shall be in accordance with the American Institute of Steel Construction (AISC) Handbook, OV Aluminum Associated Handbook, as appropriate.

3.3 DESIGN AND CONSTRUCTION

3.3.1 Materials, Processes and Parts

3.3.1.1 Materials and Processes

Materials and processes for the IVE shall utilize MIL-E-4158E as a guide. Zinc or cadmium shall not be used.

3.3.1.2 Material Compatibility

Materials and processes used in fabrication of the IVE shall be compatible with the environmental conditions specified herein.

3.3.1.3 Polyvinyl Chloride (PVC).

Polyvinyl chloride (PVC) shall not be used in the IVE components. Either Tefzel or Exar may be used as wiring insulation; reference specification MIL-W-22759/16 for Tefzel, and MIL-W-16878, Type B, for Exa

3.3.1.4 Mercury

The use of temperature sensing devices, electrical devices or any devices containing mercury or compound of mercury shall be prohibited in the IVE components.

3.3.1.5 Flammability

The IVE shall meet the flammability requirements of NHB 8060.1.

3.3.1.6 Parts Standardization

The IVE shall be designed to incorporate commercially available standard parts.

3.3.1.7 Processes. Applicable processes shall be selected from the following:

a. Soldering shall be in accordance with TBS.

b. Brazing: Brazing shall be in accordance with TBS.

c. Crimping: Crimping shall be in accordance with TBS.

d. Potting and Molding, (Electrical): Potting and molding for electrical cable assembly termination shall be in accordance with TBS.

3.3.1.8 Protective Coating and Finishes

The protective coatings and finishes for the IVE shall be as follows:

a. Primer: All sheet metal surfaces shall be primed with a minimum of one coat of zinc chromate.

b. Color Selection: Color selection of the IVE shall be as follows:

   1. All equipment shall receive an exterior finish coat of semi-gloss enamel. The finish coat shall be gray in color in accordance with FED-STD-595, color number 26440 or 26251.

3.3.2 General Design Requirements

a. Racks and Panels: Racks and panels shall be in accordance with standard TBS.

b. Toxic and Corrosive Fumes: Materials used shall not emit gases which are toxic or, when combined with the atmosphere, could generate acids or corrosive alkali.

3.3.2.1 EMC (Electromagnetic Compatibility) Design

The design objective shall be to minimize the generation of, and susceptibility to, electromagnetic interference in order to eliminate any possible deterioration of performance of IVE and surrounding systems.

3.3.2.2 Bypass Circuits

Bypass circuits used during checkout or calibration shall be designed not to override electrical or mechanical protective devices.

3.3.2.3 Protection of Openings

All vents, cable and wiring connections of the IVE shall be protected from entrance of debris or other contaminants. Protective devices shall be designed to be readily identifiable and removable for servicing and maintenance. Removal of the protective devices shall not cause accumulated debris to dump into the protected item or area. Protective devices shall be designed in a manner to preclude causing failure of the system.

3.3.2.4 Checkout Test Points

The IVE assembly electrical circuits shall include checkout test points which permit planned checkout and fault isolation tests to be made without disconnecting electrical connectors normally connected in use.

3.3.2.5 Connectors

Plugs or receptacles shall be provided with aligning pins or equivalent devices to aid in alignment and to preclude inserting in other than desired positions. The use of clocking to preclude cross connection of connectors is prohibited.

3.3.2.6 Corrosion Protection

Electrical and electronic circuit design shall minimize the malfunction or inadvertent operation caused by exposure to contaminants during operation.

3.3.2.6 Corrosion Protection (continued)

Metal parts that are subject to corrosion when exposed to the climatic and environmental conditions specified herein shall be treated to resist corrosion.

3.3.2.7 Threaded Fasteners

Threaded fasteners shall be positively locked to prevent loosening during service.

3.3.3 General Design Requirements (Fluid System)

The following general design requirements shall apply to all fluid systems:

3.3.3.1 Metallic Components

All materials in direct contact with the fluid media shall be corrosion resistant. No surface treatment applied to resist corrosion shall be considered acceptable in satisfying this requirement.

3.3.3.1.1 Tubing. Tubing shall be in accordance with TBD.

3.3.3.1.2 Flared Tube Fittings. Flared tube fittings shall conform to KSC Engineering Standard GP-425 and specification KSC-F-124. The design techniques shall preclude the possibility of misconnection or improper mating of fluid lines.

3.3.3.1.3 Bosses. Internal straight thread fluid connection bosses shall be in accordance with AND10050 or MS33649.

3.3.3.1.4 Piping. Pressure piping systems shall be in accordance with ANSI B31 series.

3.3.3.1.5 Flanges. Flanged interfaces shall have the capability of collecting hazardous gases for leakage detection and disposal.

3.3.3.1.6 Threaded Fasteners. Threaded fasteners shall be positively locked to prevent loosening during service.

3.3.3.2 Flexible Lines

Hoses shall be fabricated from tetra-flourethylene or stainless steel linings with external stainless steel braid or wrapped reinforcement as required for the application.

3.3.3.2.1 Line Restraints. Hoses operating at, or in excess of 150 psig pressures shall be enclosed by separate woven stainless steel cable sleeves secured at each end to structural supports and supported at six-foot intervals between these supports.

3.3.3.3 Permeability

Hoses utilizing polytetrafluoroethylene inner tubes or liners incorporating compounds of this material shall not be used in applications where permeation of gases through the inner tube cannot be tolerated. Gaskets and packings fabricated from permeable materials shall not be used in vacuum or pressurized gas systems.

3.3.3.4 Line Supports

The maximum distances between supports and anchors for systems fabricated of standard tubing and flared tube fittings are as follows:

a. Tube O.D. 1/8 through 3/8 to be 48 inches

b. Tube O.D. 1/2 through 7/8 to be 72 inches

c. Tube O.D. 1 through 2 to be 108 inches

3.3.3.5 Sample Ports

Sample ports shall be provided at strategic locations in the system to facilitate fluid sampling.

3.3.3.6 Dead-End Lines

The IVE shall be designed to be free from dead-ended lines or passages which prohibit flow of the flushing media.

3.3.3.7 Drain Ports

Drain ports shall be located at low points in the system.

3.3.3.8 Filters

The IVE design shall incorporate replaceable filters. Final filters shall be installed in supply lines as close to the critical interfacing elements as possible. Final filters shall be in accordance with SE-S-0073.

3.3.3.9 Flushing and Purging

The IVE shall be designed to preclude introduction of flushing or purging media into interfacing systems because of incident malfunction or error during operational cycles.

3.3.3.10 Vent Systems

Hazardous fluid systems shall be vented in accordance with the following requirements:

a. Manifolding: Use of a single vent by more than one fluid system shall be avoided. When a manifolded vent must be used, each system shall be isolated by means of check valves.

b. Limiting Discharge: Oxidizers and fuels shall not be discharged into the same vent system.

c. Inerting Systems: Fuel or toxic fluid vent systems shall be equipped with a means of diluting the vented fluid and stabilizing the vent system with an inert gas.

d. Location: Vents shall be placed in a location normally inaccessible to personnel and it shall be conspicuously identified.

e. Outlets: Oxidizer and fuel outlets to the atmosphere shall be separated sufficiently to prevent mixing of vented fluids. Vent outlets shall be designed to prevent accumulation of vented fluids in dangerous concentrations.

f. Vent Size: Vent systems shall be sized to provide minimum back pressures consistent with required venting flow rates. In no case shall back pressure interfere with proper operation of relief devices.

3.3.3.11 Pressure Gages.

Pressure gages shall register normal working pressures within the middle third of the range. Gages requiring a wide operating pressure range shall register the maximum pressure within the limits of the scale range.

3.3.3.11.1 Gage Construction. Pressure gages shall be of one piece, solid front, aluminum alloy case construction utilizing a shatter proof tempered glass window and a full diameter safety release back cover, or an adequately sized safety blowout disk. Gages shall be designed for flush front panel mounting.

3.3.3.12 Pressure Transducers

The range of the transducers shall not be less than 1.2 and shall not exceed 2.0 times the maximum operating pressure of the system.

3.3.3.13 Component Maintainability.

Fluid components such as gages, regulators, valves, etc., shall be capable of being calibrated, adjusted, tested, cleaned and flushed without removal from the unit, where practical.

3.3.3.14 Access to Controls

All controls and adjustments shall be readily accessible and easily operated by personnel.

3.3.3.15 Locking Devices

Calibration adjustment on fluid components shall be provided with locking devices where such devices are available. All calibration adjustments, locked or unlocked, shall be so designed that the setting, position, or adjustment shall not be altered when the equipment is subjected to the service condition specified.

3.3.3.16 Relief Valves

Relief valves shall reseat on decreasing pressure at a point above the maximum normal working pressure of the system. Relief valves shall be set to crack (start to flow) at not more than 110 percent of the maximum operating pressure and shall be sized to carry the maximum flow rate of the upstream pressure-reducing device at no more than 120 percent of the maximum operating pressure. A relief valve is required downstream of pressure-reducing devices whenever any portion of the downstream system cannot withstand the full upstream pressure. Under no circumstances shall normal operation of GSE cause relief valves to operate.

3.3.3.17 Pressure Regulators

Pressure regulators shall be selected to maintain set outlet pressures within required system tolerances over the entire range of expected flows. Balanced valve pressure regulators shall be used where widely varying inlet pressure would cause the set outlet pressure to exceed required tolerances. For each stage of regulation, the ratio of upstream pressure to downstream pressure should not exceed 5 for optimum control of pressure and flow.

3.3.3.17.1 Dome Loaded Pressure Regulators. Dome loaded pressure regulators shall be loaded by means of a separate spring-loaded, hand-operated regulator having an automatic downstream pressure-relief capability. A test condition shall be provided in the dome-loading circuit downstream of the loading regulator.

3.3.3.18 Two-Phase Flow

Components exposed to cryogenic fluids in the IVE shall be designed such that they are not sensitive to two-phase flow conditions and associated phenomena such as geysering.

3.3.4 Identification and Marking

3.3.4.1 Nameplates

Nameplates shall be marked in accordance with MIL-STD-130 and shall include (as applicable) item name; buyer's model number, serial number and control number; manufacturer; date of manufacturer; and manufacturer's serial number, part number, and code identification number in accordance with DOD Handbook H 4-1. Abbreviations, in accordance with MIL-STD-12, may be used.

3.3.4.2 Identification of Parts

Each fabricated part shall be identified with a part number. The same specification or part number shall be used to identify all like materials, processes, and parts. The seller shall assign a new part number to a part, when authorized changes make the superseded part not interchangeable with respect to interface, fit, form, or function and performance.

3.3.4.3 Transportation Data Plate

A transportation data plate shall be provided as applicable.

a. Center of gravity

b. Tire pressure

c. Gross weight

d. Maximum towing speed

e. Appropriate cautions and warning

3.3.4.4 Identification of Flex Lines and Rigid Tubing

All flex lines and rigid tubing shall be identified in accordance with MIL-STD-1247. In addition, all flex lines shall be identified with a stainless steel tag marked with the following:

Date (month/year) of last proof test

Fluid media

Maximum allowable working pressure

Minimum allowable bend radius

Identification number

Date (month/year) of assembly

3.3.4.5 Identification of Wiring

Wiring shall be identified in accordance with TBS.

3.3.5 Electrical Bonding

Electrical bonding shall meet the requirements of TBS.

3.3.6 Interchangeability

Assemblies, components, and parts with the same part number shall be physically and functionally interchangeable.

3.3.7 Human Performance/Human Engineering

The design shall consider the capability and limitations of the human operator wherever a man-machine interface exists. The principal design guide for the man-machine interface shall be MIL-STD-1472.

3.3.8 Dissimilar Metals

Dissimilar metals as defined in MS33586 shall not be used in intimate contact unless suitably protected against electrolytic corrosion. When it is necessary that dissimilar metals be assembled together, a material compatible with each shall be interposed between them.

3.3.9 Workmanship

The IVE shall be fabricated and finished so that appearance, fit, and adherence to specified dimensions and tolerances are observed; and in a manner which will ensure reliable operations in accordance with the requirements specified herein. Particular attention shall be given to the neatness and thoroughness of constructions, and to the freedom of parts from burrs and sharp edges that might damage associated equipment or cause injury to personnel.

3.3.10 Cable Assemblies

The IVE shall contain cable assemblies in accordance with paragraph 8.3.1.2, Figure 8-9.

3.4 CONFIGURATION MANAGEMENT

a. Change Control. Seller shall not make any changes in the configuration or in the controlled methods and processes used in the manufacture of the article ordered hereunder without the prior written authorization and direction of the buyer. If seller requests buyer approval of an engineering change to buyer's control document, or an engineering change to an article procured from a subordinate source in accordance with a buyer's control document, seller shall describe fully to buyer, in writing, the nature of the proposed change, and the anticipated impact in this order, including the effect on technical performance, interface conditions, schedule, and price.

3.5 LOGISTICS SUPPORT

Design characteristics and operation of the IVE will be considered by the seller when recommending to buyer the maintenance and operational support requirements. Sellers support recommendations; e.g., spare parts maintenance cycles, and maintenance activities, should be considered to properly establish the maintenance/support concept.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 GENERAL VERIFICATION GUIDELINES AND CRITERIA

The seller shall use the following general requirements in developing a verification program.

a. Performance and design requirements specified in this specification shall be verified by test, assessment, or examination of product in support of verification of the design for operational use.

b. Verification of maintainability, accessibility, and ease of operation shall be performed by assessment.

4.1.1 Test Conditions

4.1.1.1 Standard Test Conditions

Environmental standard test conditions for tests required by this specification shall be: An atmospheric pressure of 28.5 plus 2 or minus 4.5 inches of mercury (Hg), a temperature of 73° plus 7° or minus 13°F and a relatively himidity of 50 plus 20 or minus 5 percent.

4.2 TEST RESPONSIBILITY AND LOCATION

The seller shall be responsible for implementing the quality assurance requirements specified herein. Except as otherwise noted, the seller may use his own facilities or any commercial laboratory acceptable to the buyer.

4.3 QUALITY CONFORMANCE

Items covered by this specification shall be subjected to the following, as defined by Table I, to determine compliance with all specified requirements.

4.3.1 Acceptance

Acceptance inspection and tests shall be performed on all IVE systems delivered to the buyer. The seller shall perform any other test deemed necessary, subject to approval by the buyer. The final tests and inspections shall be performed in a manner and under conditions which simulate end

uses to the highest degree practicable without damage to the units. The degree, duration, and number of tests shall be sufficient to verify that the quality required is present.

4.3.1.1 Examination of Product

Each IVE shall be carefully examined to determine conformance to the requirements of this specification. Particular attention shall be given to workmanship, finish, dimensions, construction, identification, marking, and to the use of materials and processes.

4.3.1.2 Functional and Performance Tests

Acceptance tests shall be conducted on all deliverable equipment to establish conformance with the functional and performance requirements of Section 3. The tests shall be performed in a manner and under conditions which simulate end item use to the highest degree practicable without damage to the units. Tolerance bands or pass-fail performance criteria, based on performance design requirements, shall be established for each test.

4.3.2 Assessment

Verification by assessment methods may be used to verify design features. These methods employ the orderly review and evaluation of design (drawings) or visual inspection techniques (i.e., mockup forms, fit checks, maintainability access, tolerances, safety wiring and placards).

4.3.3 Verification Requirements Matrix

The sellers verification program shall satisfy the performance and design verification requirements specified in Table 4.1. Where a verification method is not indicated, the seller shall propose a suitable approach to requirement verification. Alternate verification approaches may be recommended by the seller.

TABLE 4.1 PERFORMANCE & DESIGN VERIFICATION MATRIX
Structures & Mechanisms

Sections 3 and 5 Requirement No.	4.3.1.1 Examination of Product	4.3.1.2 Funct. & Performance Test	4.3.2 Assessment
7.3.2.2.1	X		
7.3.1.2.2	X		
7.3.2.1		X	X
7.3.2.1.1			X
7.3.2.2.1 thru 3.2.2.4			X
7.3.2.3.1			X
7.3.2.3.2			X
7.3.2.4.1 thru 3.2.4.3			X
7.3.2.5.1			X
7.3.2.6.1 thru 3.2.6.4		X	X
7.3.2.7.1 thru 3.2.7.2			X
7.3.3.1 thru 3.3.1.8			X
7.5.2.1	X		
7.5.3	X		

TABLE 4.1 PERFORMANCE & DESIGN VERIFICATION MATRIX

Sections 3 and 5 Requirement No.	Electrical Subsystem 4.3.1.1 Examination of Product	4.3.1.2 Funct. & Perform. Test	4.3.2 Assessment
8.3.1.2.1.2 thru 8.3.1.2.1.5	X	X	
8.3.1.2.2	X		
8.3.1.2.2.1	X		
8.3.1.2.3			X
8.3.1.2.4		X	
8.3.1.2.5.2		X	
8.3.1.3	X		
8.3.1.4	X		
8.3.2.1		X	X
8.3.2.1.1			X
8.3.2.1.4.1 thru 8.3.2.1.5.15		X	
8.3.2.6.1 thru 8.3.2.1.6.4		X	X
8.3.2.1.7.1 thru 8.3.2.1.7.3		X	X
8.3.2.1.8.1		X	X
8.3.2.1.8.2		X	X
8.3.2.2.1 thru 8.3.2.2.4			X

TABLE 4.1 (CONT.) PERFORMANCE & DESIGN VERIFICATION MATRIX

Sections 3 and 5 Requirement No.	4.3.1.1 Examination of Product	4.3.1.2 Funct. & Perform. Test	4.3.2 Assessment
8.3.2.3.1			X
8.3.2.3.2			X
8.3.2.3.3			X
8.3.2.4.1 thru 8.3.2.4.4			X
8.3.2.5.1			X
8.3.2.5.2			X
8.3.2.6.1 thru 8.3.2.6.4			X
8.3.2.7.1 thru 8.3.2.7.3			X
8.3.3.1 thru 8.3.3.10			X
8.5.1.1	X		
8.5.1.2	X		

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5.0 PREPARATION FOR DELIVERY

5.1 GENERAL REQUIREMENTS

The requirements specified herein govern the preparation for shipment and the transport of the IVE to all buyer and government facilities. The methods of preservation, packaging and packing utilized for shipment shall adequately protect the IVE from damage or degradation of performance due to the natural and induced environments encountered during transportation and subsequent storage as specified herein.

5.2 DETAILED REQUIREMENTS

Packaging, handling, and transportation shall be in accordance with applicable requirements specified herein.

5.2.1 Preservation, Packaging and Packing

Preservation, packaging, and packing shall be in accordance with the requirements of Level B of MIL-STD-794.

5.3 MARKING FOR SHIPMENT

Interior and exterior containers shall be marked and labeled in accordance with MIL-STD-129 including precautionary markings necessary to ensure safety of personnel and facilities, and to ensure safe handling, transport and storage. Identification information on interior and exterior containers shall be in the following format and shall include:

BUYER CONTROL NUMBER ______________________
ITEM NAME ______________________
FSN/NATO STOCK NUMBER (When Applicable ______________________
MANUFACTURER'S TYPE OR PART NUMBER ______________________
QUANTITY IN PACKAGE (As Applicable) ______________________
AGE CONTROL MARKING (When Applicable) ______________________
SERIAL NUMBER ______________________
MANUFACTURER ______________________
BUYER PURCHASE ORDER NUMBER ______________________
DATE OF PACKAGING ______________________

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6.0 NOTES

6.1 DEFINITIONS

6.1.1 Acceptance Tests

Inspection and tests to determine that a part, component, subsystem, or system is capable of meeting design and performance requirements specified herein.

6.1.2 Assessment

A verification method employing inspection and review of design techniques to verify design features not covered by verification of test and analysis such as finishes, tolerances, bonding identification and traceability, safety wiring, warning and servicing labels, Bill of Materials, etc.

6.1.3 Unsheltered

An open area, unprotected against environmental conditions.

6.1.4 Useful Life

The item's total life span including operating life and storage with normal preventive maintenance, servicing, repair, and replacement of parts before item is considered unacceptable for further usage. This life span may be equal to (throw-away) or greater than (repair, refurbishable) the value specified for "operational life."

6.1.5 Verification

The process of planning and implementing a program that determines theat the item meets all design, performance, and safety requirements. The verification process includes acceptance testing, assessment and analysis necessary to support the total verification plan.

6.2 ABBREVIATIONS AND ACRONYMS

Abbreviations and acronyms used in this specification are defined as follows: (As Applicable).

ac	Alternating current
ACU	Audio Control Unit
ADS	Audio Distribution System
AFDS	Aft Flight Deck Set
AIE	Avionics Interface Element
Al	Aluminum
amp	Ampere
ATCS	
atten	Attenuator
avg	Average
BI-Ø-L	Bi-Phase-Low-Bits-per-inch
BPI	
Btu	British thermal unit
BW	Bandwidth
CCTV	Closed Circuit Television
C&DH	Communications & Data Handling
C/CPU	Controller/Central Processor Unit
CG	Center of Gravity
cm_3	Centimeter
C_m	Cubic centimeter
CPM	Cards-per-minute
C&W	Caution & Warning
C&WE	Caution & Warning Electronics
CRT	Cathode Ray Tube
db	Decibel
dbm	decibel referenced to 1 milliwatt
dc	Direct Current
D&C	Display & Control
DØH	Discrete in - High
DIL	Discrete in - Low
DOH	Discrete Out - High
DOL	Discrete Out - Low
DMA	Direct Memory Access
EMC	Electromagnetic compatibility
ETD	Electrical Terminal Distributor
ECUS	Environmental Control Unit Set

F	Fahrenheit
FCOS	Flight Computer Operating System
ft^2	Foot or Feet
ft^3	Square foot or feet
ft	Cubic feet
FSN	Federal Stock Number
g	Gravity
GSE	Ground Support Equipment
GMT	Grenwich Mean Time
hr	Hour
Hz	Hertz (cycles per second)
I/F	Interference
in.	inch
IPS	Inchs-per-second
I/O	Input/Output
IRIG	Inter Range Instrumentation Group
IVE	Interface Verification Equipment
k	Kilo
KBPS	Kilobits per second
Kg	Kilograms
kHz	KiloHertz (kilocycles per second)
Km	Kilometers
lb	Pound
LPM	Lines-per-minute
LPS	Launch Processing System
M	Meter
ma	Milliampere
MBPS	Megabit per second
MET	Mission Elapsed Time
Mg	Milligram
MHz	Mega Hertz (megacycles per second)
mm	Millimeter
ms	Millisecond
MS	Mission station
mv	Millivolt
N_2	Nitrogen
NA	Not applicable
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treatry Organization

NMT	No More Than
NRZ-L	Non Return to Zero-Low
nsec	Nanosecond
O	Oxygen
OOS	On-Orbit Station
OSC	Oscillator
PCA	Power Control Assembly
PCI	Program Control-In
PCM	Pulse Code Modulation
PCO	Program Control-Out
PDI	Payload Data Interleaver
phm	Parts per hundred million
P/L	Payload
PPS	Pulse per second
PSP	Payload Signal Processor
PS	Payload Station
psi	Pounds per square inch
psia	Pounds per square inch absolute
psid	Pounds per square inch differential
psig	Pounds per square inch guage
RC	Resistance capacitance
rf	Radio Frequency
rms	Root mean square
RTOS	Real Time Operating System
sec	Second
SGP	Static Ground Point
std	Standard
SWR	Standing Wave Ratio
TBD	to be determined by Buyer
TBS	to be supplied by Seller (with the proposal)
TDM	Time Division Multiplex
TLM	Telemetry
TMU	Test Measurement Unit
TP	Twisted Pair
TSP	Twisted Shielded Pair
usec	Microseconds
vac	Volts alternating current
vdc	Volts direct current

7.0 STANDARD IVE STRUCTURE AND MECHANISM SUBSYSTEMS

7.1 SCOPE

This section established the performance, design, and verification requirements for the development of the Standard IVE Structure and Mechanism (S&M) Subsystems of the Interface Verification Equipment. The S&M subsystems operating integrally with the Electrical & Fluid Subsystem provides simulation of all physical and functional interfaces between the Orbiter and payload. The structure subsystem consists of a primary structure (mid-body fuselage) and secondary structure which includes an aft flight deck support, X_o576 bulkhead, X_o1307 bulkhead, payload wire tray, preflight umbilical panel provision, RMS and door actuator critical interference envelopes and adjustable floor jacks. The mechanism subsystem consists of payload interface elements which include a primary longeron fitting bridge-nondeployable payload, stabilizing longeron fitting/bridge-nondeployable payload, auxiliary keel fitting and bridge for Y-Y loads and X_o679.5 power interface panel.

7.2 APPLICABLE DOCUMENTS

See Paragraph 2.0.

7.3 REQUIREMENTS

The requirements of Paragraph 3.0 are applicable to this section.

7.3.1 Item Definition

The structure and mechanism (S&M) subsystems shall perform the following functions:

(a) Provide capability to determine payload form, fit and function compatibility verification within the Orbiter payload bay.

(b) Provide capability to support up to a maximum payload of 65,000 pounds in both a horizontal and vertical mode.

(c) The S&M subsystems and the electrical subsystems shall be designed for use as individual pieces of test equipment. They shall also be designed for combined use as a single test fixture forming the IVE system.

(d) Provide capability for payload retention.

(e) Support development and checkout of payload installation and removal procedures/timelines.

(f) Support payload design and development.

(g) Support crew training.

(h) IVE structure subsystem shall be capable of being disassembled, transported to new site, reassembled and verified for operations.

7.3.1.1 Item Diagram

Figure 7-1 is representative of a standard horizontal configuration of the S&M subsystems.

7.3.1.1.1 Item Description

The S&M subsystem consists of the following:

7.3.1.1.1.1 Major Elements of the S&M Subsystem

The major structural and payload interface elements of the S&M subsystems are:

a. Midbody structure

b. Aft crew station support structure

c. X_o576 bulkhead

d. Xo1307 bulkhead

e. Payload wire trays

f. Preflight umbilical panel provisions

g. RMS and door actuator critical interference envelopes

h. Adjustable floor jacks

i. Primary longeron fitting-nondeployable payload

j. Stabilizing longeron fitting - nondeployable payload

k. Auxiliary keel fitting, Y-Y loads

l. X_o679.5 power interface panel

m. Support equipment

   1. Hoist/spreader bar

   2. Payload mass simulator

   3. Master alignment tool

7.3.1.1.2 Primary Structure Description

The primary structure shall be defined as all load carrying structural members required to support a maximum payload of 65,000 pounds. The structural configuration shall be capable of supporting the maximum payload and all related equipment in both a horizontal and vertical mode.

7.3.1.1.2.1 Midbody Structure

The midbody structure shall consist of three structural sections capable of being connected together to dimensionally simulate a 15 feet wide by 60 feet long Orbiter midbody fuselage. The three sections shall be identical in size and design excluding provisions for joining the sections together and for mounting secondary structure, payload interface elements and optional equipment. Structural provisions shall be provided for installing payload attach fittings in the longeron and keel area to accommodate the Orbiter 3.933 inch vernier concept. The sections shall be a modular design and capable of alignment in the X, Y and Z axes during assembly. Fabrication tolerances for the payload interfaces shall be controlled to less than one-half of the Orbiter fabrication tolerances. The structural assemblies shall be fabricated from weldable low carbon tubular steel utilizing standard commercial shapes to provide a cost effective product.

For detailed items and description of the midbody structure, refer to Figure 7-2 and the hardware utilization list in Volume II of this report. The major components of the midbody structure consists of:

a. Midbody sections

b. Vertical truss assembly

c. Horizontal cross beam

d. Diagonal tie rod

e. Clevis rail

f. Bridge rail

g. Connector plate

h. Keel beam and fitting support

7.3.1.1.3 Secondary Structure

The secondary structure shall be defined as all remaining structure not identified as primary structure or as payload interface elements. This shall include all the structure required in support of the payload interface elements and optional equipment.

7.3.1.1.3.1 Aft Flight Deck Support Structure

The aft crew station support structure shall perform the following functions:

a. Support the MS/PS/OOS consoles

b. Support the X_O576 bulkhead

c. Provide work platform for crew personnel

d. Provide mounting provisions for optional equipment and interfaces.

The support structure shall be of modular design and capable of alignment during assembly in the X, Y and Z axis. The structure shall be fabricated of weldable low carbon tubular steel utilizing existing shapes to produce a cost effective structural assembly.

For detailed items and description of the aft crew station structure, refer to Figure 7-3 and the Hardware Utilization List in Volume II of this report. The major components of the structure consists of:

a. Modular support structure

b. Floor plate

c. Handrails

d. Leveling screws

7.3.1.1.3.2 X_o576 Bulkhead

The X_o576 bulkhead assembly shall perform the following functions:

a. Provide a structural enclosure for the aft end of the aft crew station.

b. Provide support structure for the payload electrical feed thru panels.

c. Provide aft observation - window cutouts.

The X_o576 bulkhead structure shall be designed and fabricated in a cost effective manner using conventional skin and stringer type construction. Provisions shall be included for attaching to the aft crew station support structure.

For detailed items and description of the X_o576 bulkhead structure, refer to Figure 7-4 and The Hardware Utilization List in Volume II of this report.

7.3.1.1.3.3 X_o1307 Bulkhead

The X_o1307 bulkhead assembly shall perform the following functions:

a. Provide a structural enclosure for the aft end of the payload bay at X_o1307.

b. Provide support structure for the payload electrical and fluid connector panels.

c. Provide access hatch cutout in bulkhead

d. Provide support structure for T-0 umbilical panels.

The X_o1307 bulkhead structure shall be designed and fabricated in a cost effective manner using conventional skin and stringer type construction. The bulkhead design shall be compatible with commercial air freight volumetric requirements. Structural provisions shall be included for attaching the bulkhead to the mid-body structure at Station X_o1307.

For detailed items and description of the X_o1307 bulkhead structure, refer to Figure 7-5 and the Hardware Utilization List in Volume II of this report.

7.3.1.1.3.4 Payload Wire Tray(s)

The payload wire trays shall be capable of supporting the payload wire harnesses (left and right sides) from X_o576 to the payload and from X_o1307 to the payload. The wire tray design shall include a method permitting quick removal and installation of payload wiring (simulate Orbiter operation). Electromagnetic compatibility (EMC) shielding shall be provided as required in the trays. The right hand tray shall accommodate the payload power cables from $X_o679.5$ to the payload. The tray design shall provide wire exits at all possible payload station locations. Wire trays shall be provided on the aft face of X_o576 bulkhead (left and right sides) for payload wiring routed from the electrical feed thru panels to the horizontal wire trays.

For detailed items and description of the payload wire tray, refer to Figure 7-6 and the Hardware Utilization List in Volume II of this report.

7.3.1.1.3.5 Preflight Umbilical Panel Provisions

Structural provisions shall be made to support the electrical and fluid preflight umbilical panels located at Station X_o836 on the left side of the midbody structure.

7.3.1.1.3.6 RMS and Door Actuator Critical Interference Envelopes

The IVE shall provide a means to determine payload trunnion interference with Orbiter subsystem elements along the longeron/sill structure. Specific items which can cause critical interference include remote manipulator supports, door actuators, radiator lines, electrical connectors and overhinge linkage and structural hinge support brackets. Critical interference envelopes for these elements shall be defined and physically blocked out on the longeron structure in a manner similiar to that shown in Figure 7-7.

7.3.1.1.3.7 Adjustable Floor Jacks

Adjustable floor jacks shall be incorporated in the design of the midbody structure and the aft crew station support structure to provide vertical adjustment during alignment/assembly.

For detailed items and description of floor jacks, refer to Figure

7-8 and the Hardware Utilization List in Volume II of the report.

7.3.1.1.4 Payload Interface Elements

The mechanism subsystem shall provide as part of the standard IVE unit the following payload interface elements.

7.3.1.1.4.1 Primary Longeron Fitting (Non - Deployable)

The non-deployable primary longeron fitting shall provide the primary structural interface between the payload trunnion and the IVE bridge rail. The interface shall be an exact simulation of the Orbiter to payload interface. The longeron fitting shall be capable of supporting a 65,000 pound static payload along the X-X and Z-Z axes in both the horizontal and vertical configuration. The payload trunnion shall be free to move along the Y-Y axis. Three degrees freedom of motion shall be provided between the payload and the bridge rail to accommodate angular movement/misalignment during verification operations. The longeron fitting shall index to the bridge rail in a positive manner at all required X_o station locations.

For detailed items and description of the primary longeron fitting, refer to Figure 7-9 and the Hardware Utilization List in Volume II of this report. The major components of the longeron fitting consits of:

a. Upper Journal - pivoting

b. Lower Journal

c. Bearing - ball

d. Bearing - race

e. Pin - shear

f. Pivot bolt

g. Lock bolt

One left and one right hand configuration of the primary longeron fitting shall be provided. Additional units shall be available to the User as optional equipment (Paragraph 10.4.1).

7.3.1.1.4.2 Stabilizing Longeron Fitting (Non-Deployable)

A non-deployable stabilizing longeron fitting shall provide a stabilizing structural interface between the payload trunnion and the IVE

bridge rail. The longeron fitting shall be capable of supporting a 65,000 pound static payload in the Z-Z axis in both the horizontal and vertical configurations. The payload trunnion shall be free to move in the Y-Y axis. Three degrees of freedom shall be provided between the payload and bridge rail to accommodate angular movement/misalignment during verification locations.

The stabilizing longeron fitting shall be identical to the primary longeron fitting (7.3.1.1.4.1) except as noted above. Additional units shall be availabe to the User as optional equipment (Paragraph 10.4.2).

7.3.1.1.4.3 Auxiliary Keel Fitting

The auxiliary keel fitting shall provide a structural interface between the payload tongue and the IVE keel structure. The interface shall be an exact simulation of the Orbiter to payload interface. The keel fitting shall be capable of supporting a 3250 pound load in the Y-Y axis in both the horizontal and vertical configuration. The payload tongue shall be free to move in the Z-Z axis. The fitting shall index to the keel support structure in a positive manner at all required station locations.

For detailed items and description of the auxiliary keel fitting, refer to Figure 7-10 and the Hardware Utilization List in Volume II of this report. Additional units shall be available to the User as optional equipment (Paragraph 10.4.5).

7.3.1.1.4.4 Power Interface Panel

The power interface panel shall be located on the right side of the IVE midbody structure at approximately station X_o679.5. The panel shall be an integral part of the payload wire tray design and simulate the Orbiter to payload interface. A 12kw dc primary power outlet and two 0.5kw dc emergency power outlets shall be provided on the panel. An optional 8kw maximum protective circuit device shall be provided for the primary power outlet. Space shall be reserved on the panel for a 8kw redundant dc power outlet.

An illustration of the design concept for the power interface panel is shown in Figure 7-11.

7.3.1.1.5 Mechanical Support Equipment

Mechanical support equipment shall be provided for handling and support during assembly and checkout of the structure subsystem at the users site. Two hoist cross bars shall be provided to maintain structural

stability of the mid-body sections during handling operations. Two precision spacing tools shall be provided for support during structural assembly operations and checkout.

7.3.1.1.5.1 Hoist Cross Bar

The open ends of the three mid-body structural sections must be stabilized in order to prevent structural deformation of the midbody sections during handling operations. The hoist cross bar shall attach to the longeron members of each section and provide the required stiffness to stabilize the structure.

7.3.1.1.5.2 Master Alignment Tool

A master alignment tool shall be provided to facilitate assembly and alignment of the structure subsystem. The alignment tool shall be designed to locate and/or align the longeron bridge rail, keel fitting and support, interface elements and optional equipment.

7.3.2 Item and Major Components Identification

The identification of the structure and mechanism subsystems and its major components shall be as follows:

Nomenclature	Mfr. Code Ident. No.	Buyer Control No.	Seller Part No.
TBD	TBD	TBD	TBD

7.3.3.1 Buyer Furnished Property

The following items will be supplied by the buyer and shall be incorporated into the Structure and Mechanism Subsystems:

Nomenclature	Part No.
TBD	TBD
TBD	TBD

7.3.4.2 Buyer Directed Procurement

The following components shall be procured by the seller for incorporation into the Structure and Mechanism Subsystems:

Nomenclature	Part No.	Specification No.	Supplier
TBD	TBD	TBD	TBD
TBD	TBD	TBD	TBD

7.3.5 Useful Life

As a design objective, the useful life of the structure and mechanism subsystems shall be as follows:

The unit shall have a operating life of 10 years. The unit shall be capable of operating TBD hrs/week for TBD weeks. During this period, preventive maintenance, repair, or calibration may be accomplished to maintain specific performance.

7.3.6 Physical Characteristics

7.3.6.1 Weight

The weight of the structure and mechanism subsystems shall not exceed the design sepcification weight (TBD).

7.3.6.2 Hoisting, Lifting and Handling

The structure and mechanism subsystems shall have hoisting, lifting, and handling provisions as applicable.

7.3.6.3 Mobility

The structure and mechanism subsystems shall have limited mobility only during handling and assembly operations.

7.4 QUALITY ASSURANCE PROVISIONS

The quality assurance provisions of Paragraph 4.0 are applicable to this section.

7.5 PREPARATION FOR DELIVERY

The delivery requirements of Paragraph 5.0 are applicable to this section.

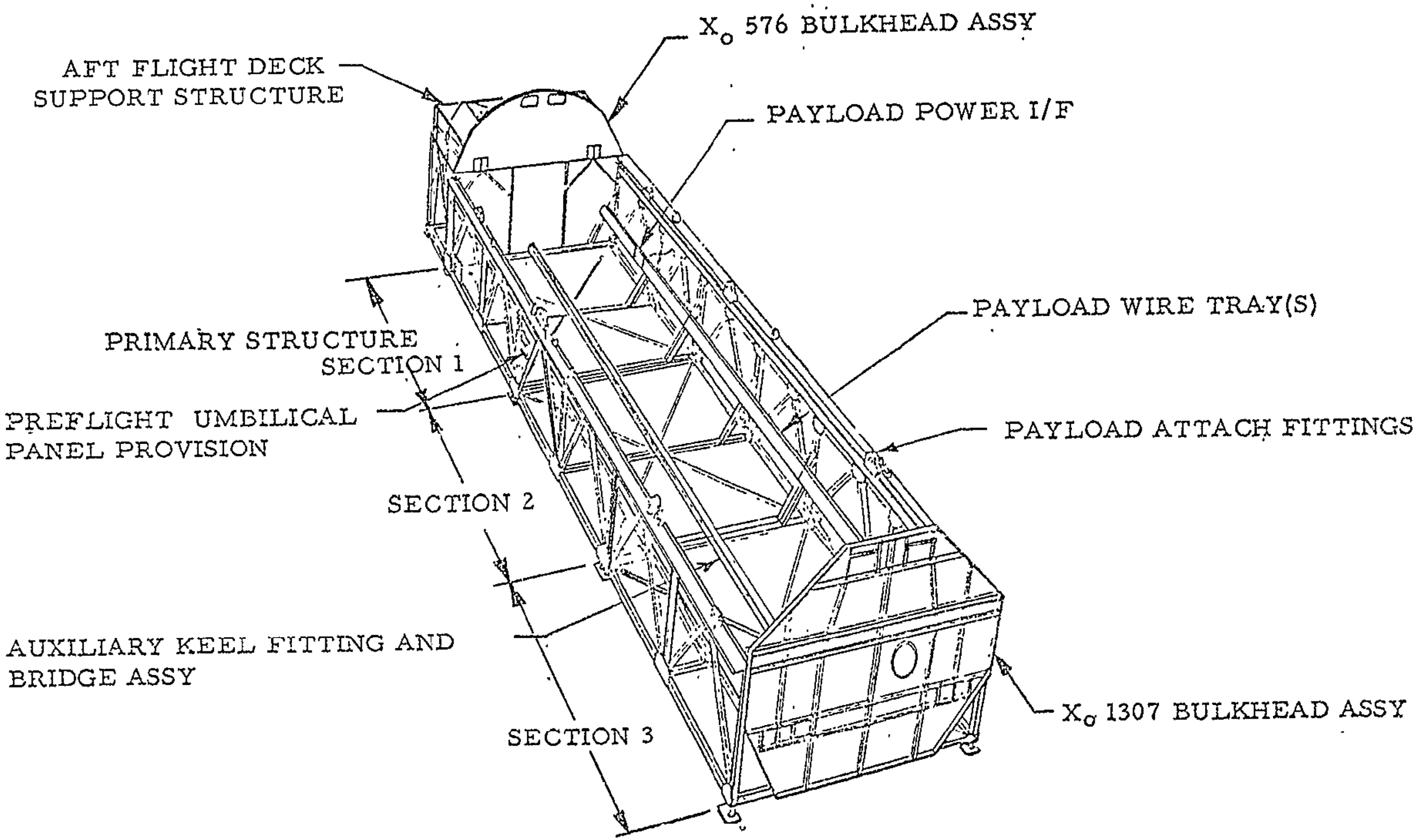

FIGURE 7-1 STANDARD IVE STRUCTURE AND MECHANISM SUBSYSTEMS

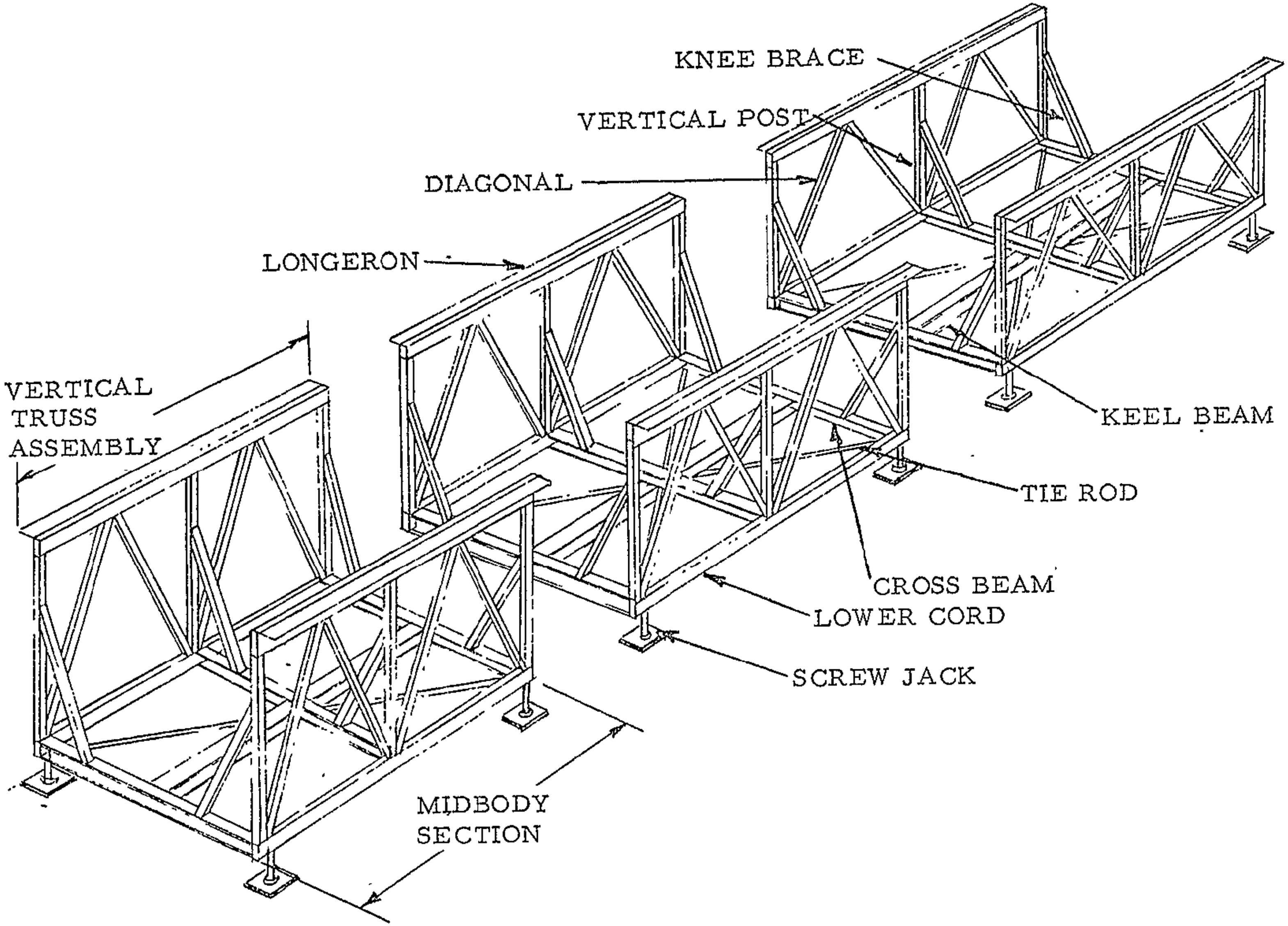

FIGURE 7-2 HORIZONTAL IVE MIDBODY STRUCTURE

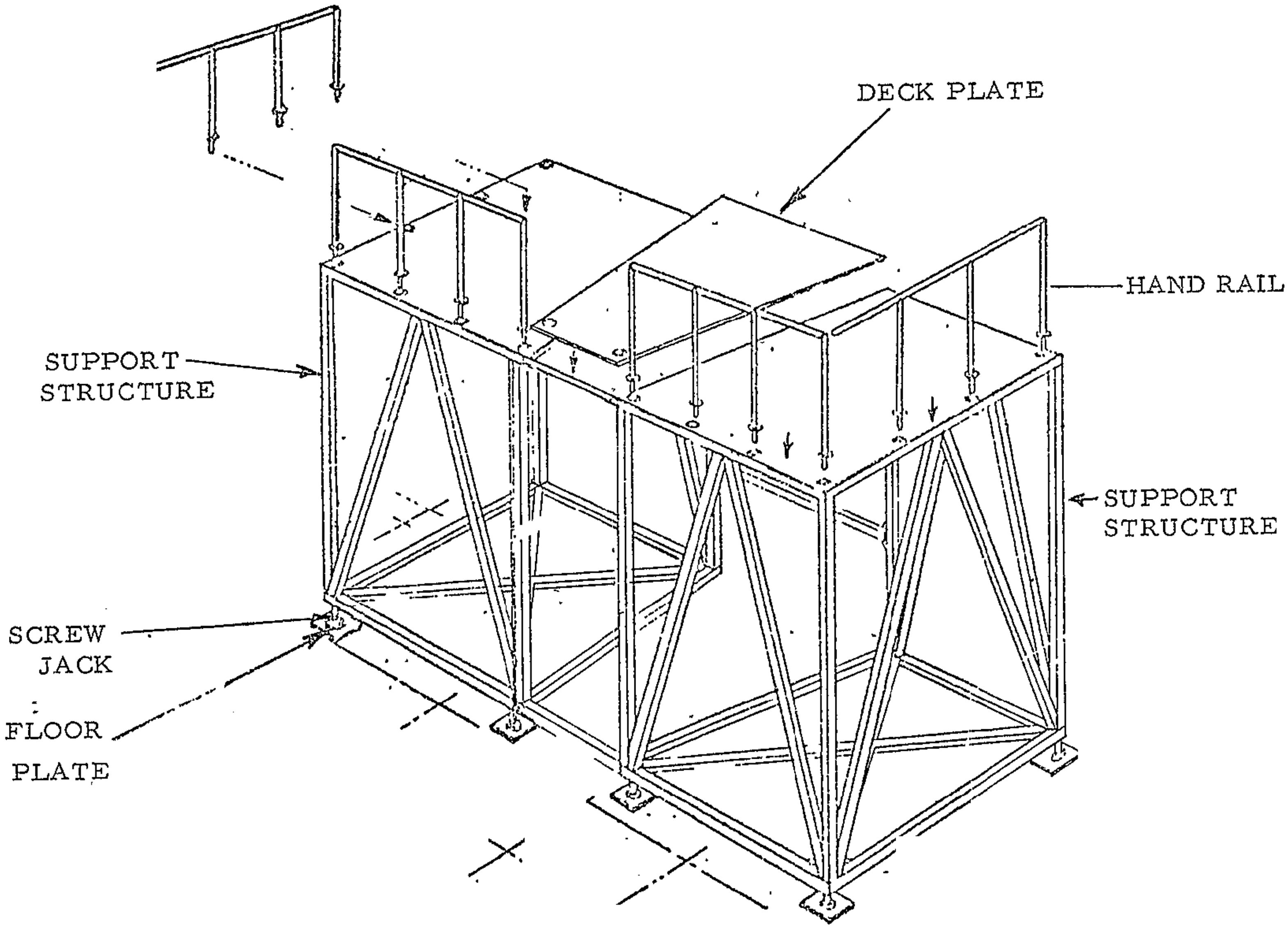

FIGURE 7-3 AFT FLIGHT DECK SUPPORT STRUCTURE

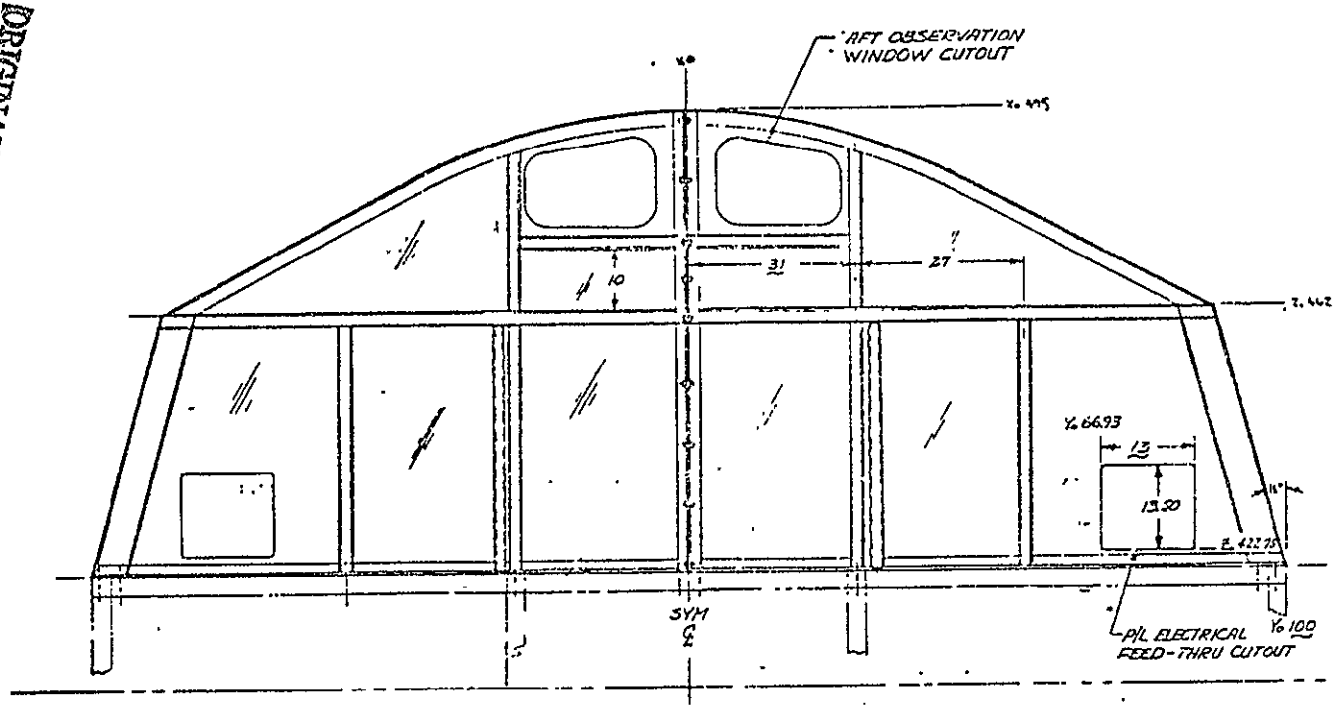

FIGURE 7-4 X_o576 BULKHEAD

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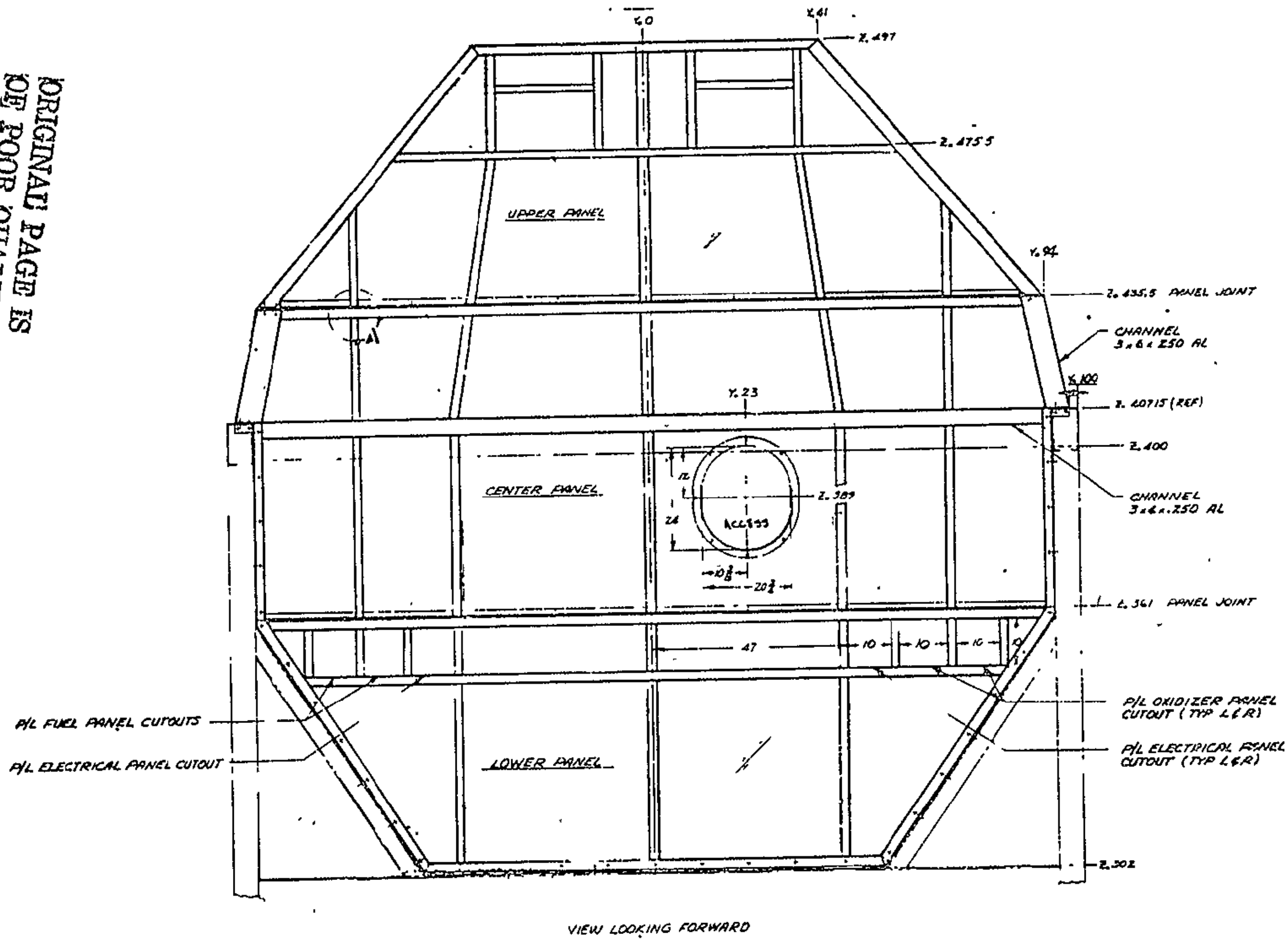

FIGURE 7-5 X_o 1307 BULKHEAD

Rockwell International
Space Division

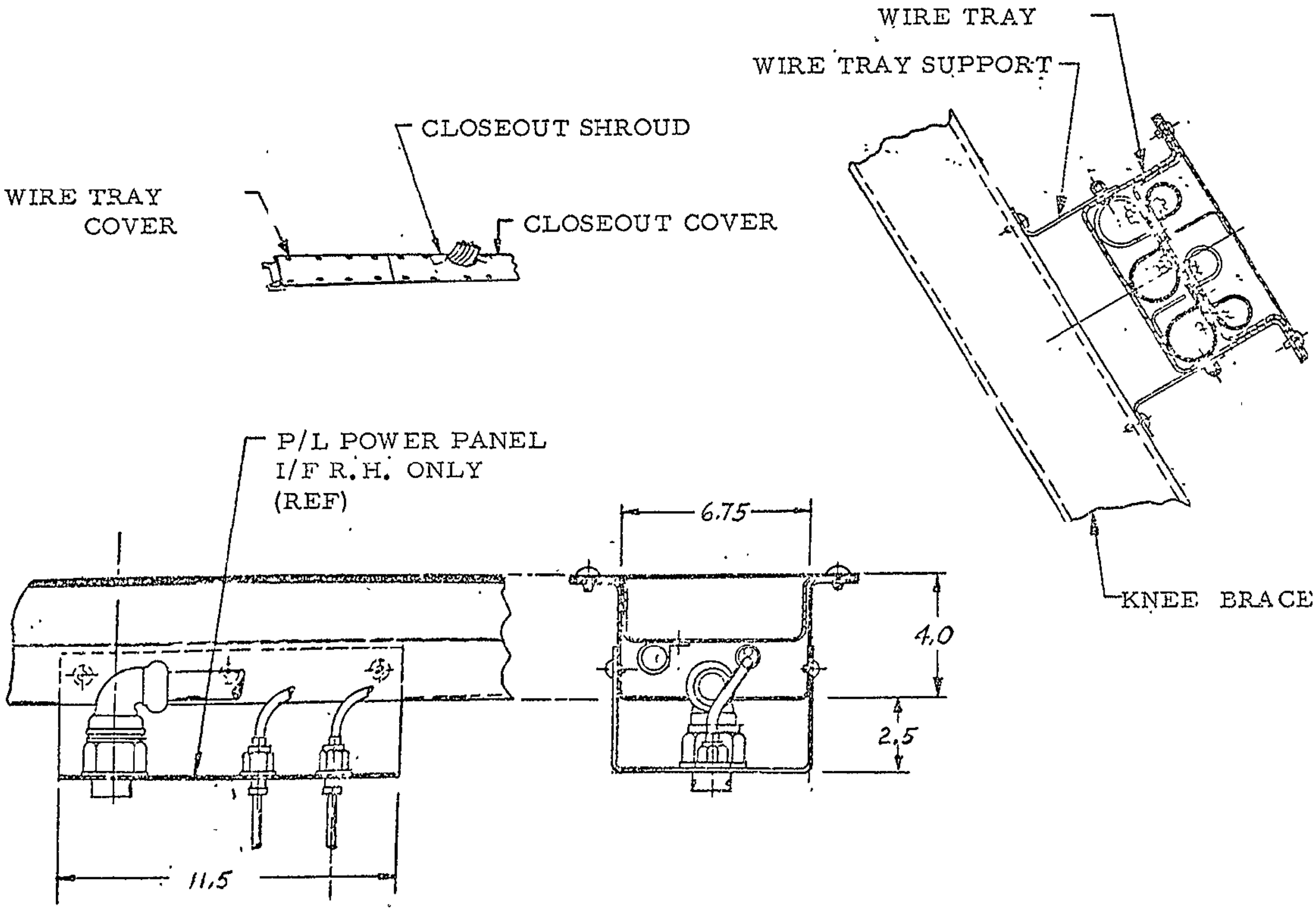

FIGURE 7-6 PAYLOAD WIRE TRAY(S)

Rockwell International
Space Division

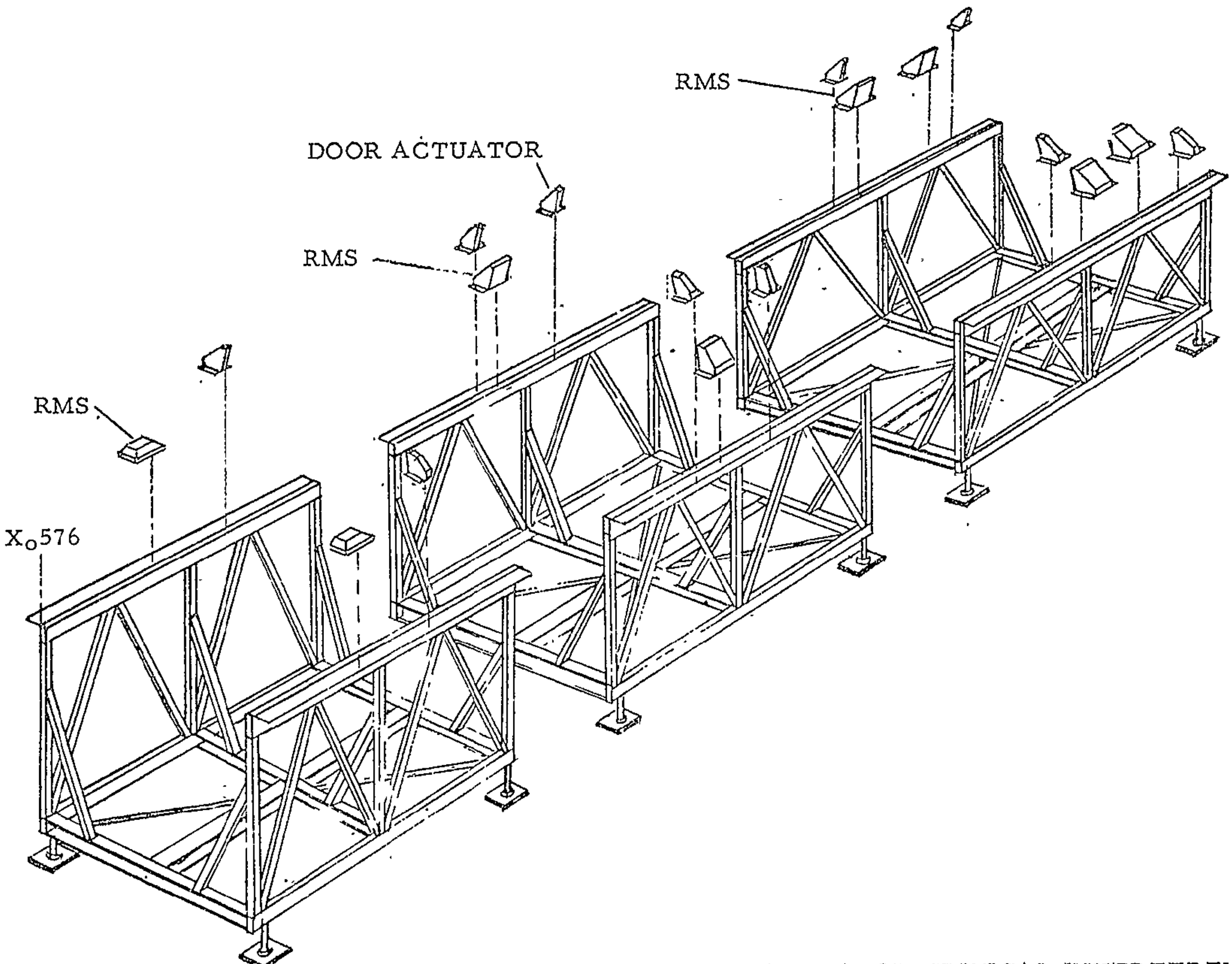

FIGURE 7-7 RMS AND DOOR ACTUATOR CRITICAL INTERFERENCE ENVELOPES

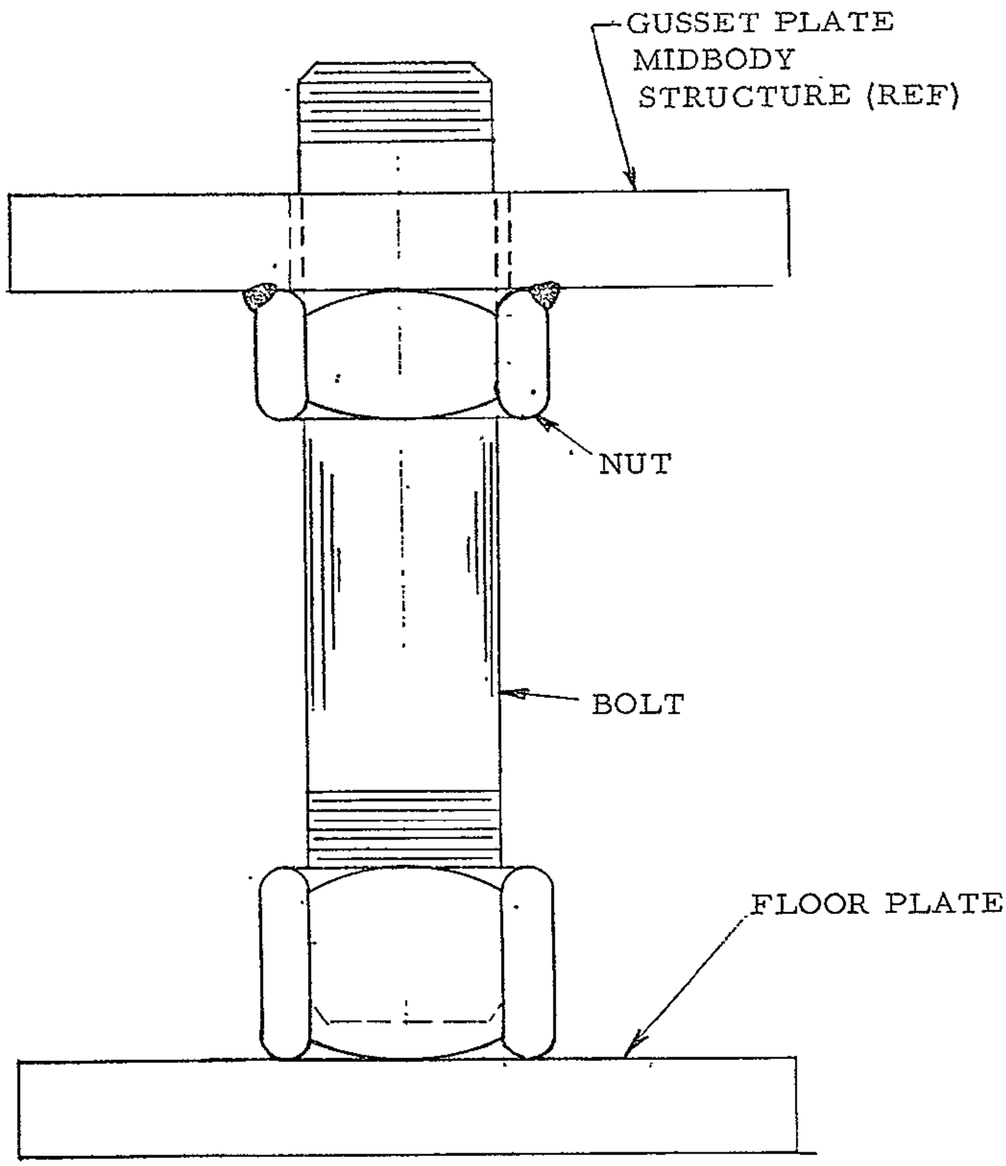

FIGURE 7-8 FLOOR JACK

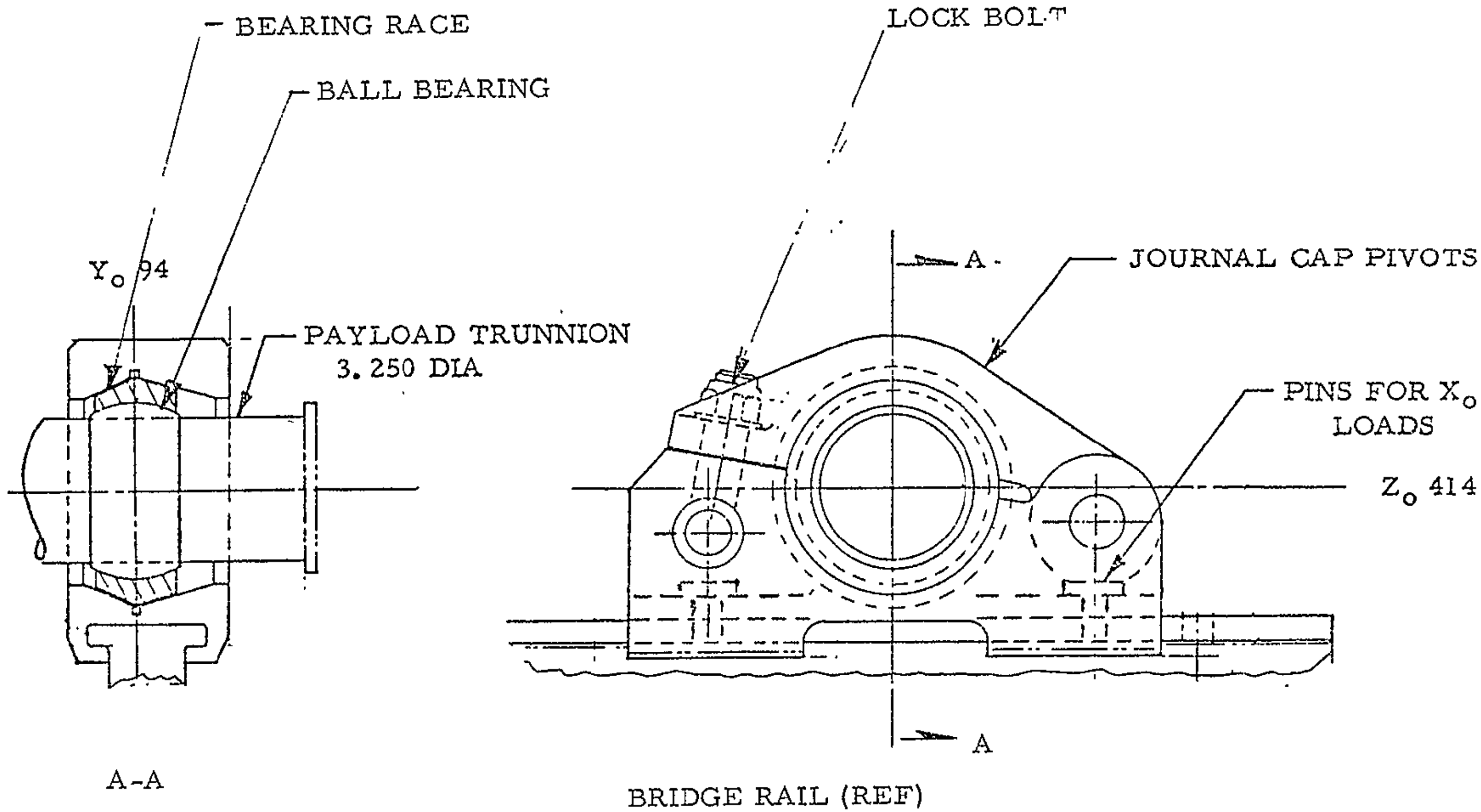

FIGURE 7-9 PRIMARY LONGERON FITTING - NONDEPLOYABLE

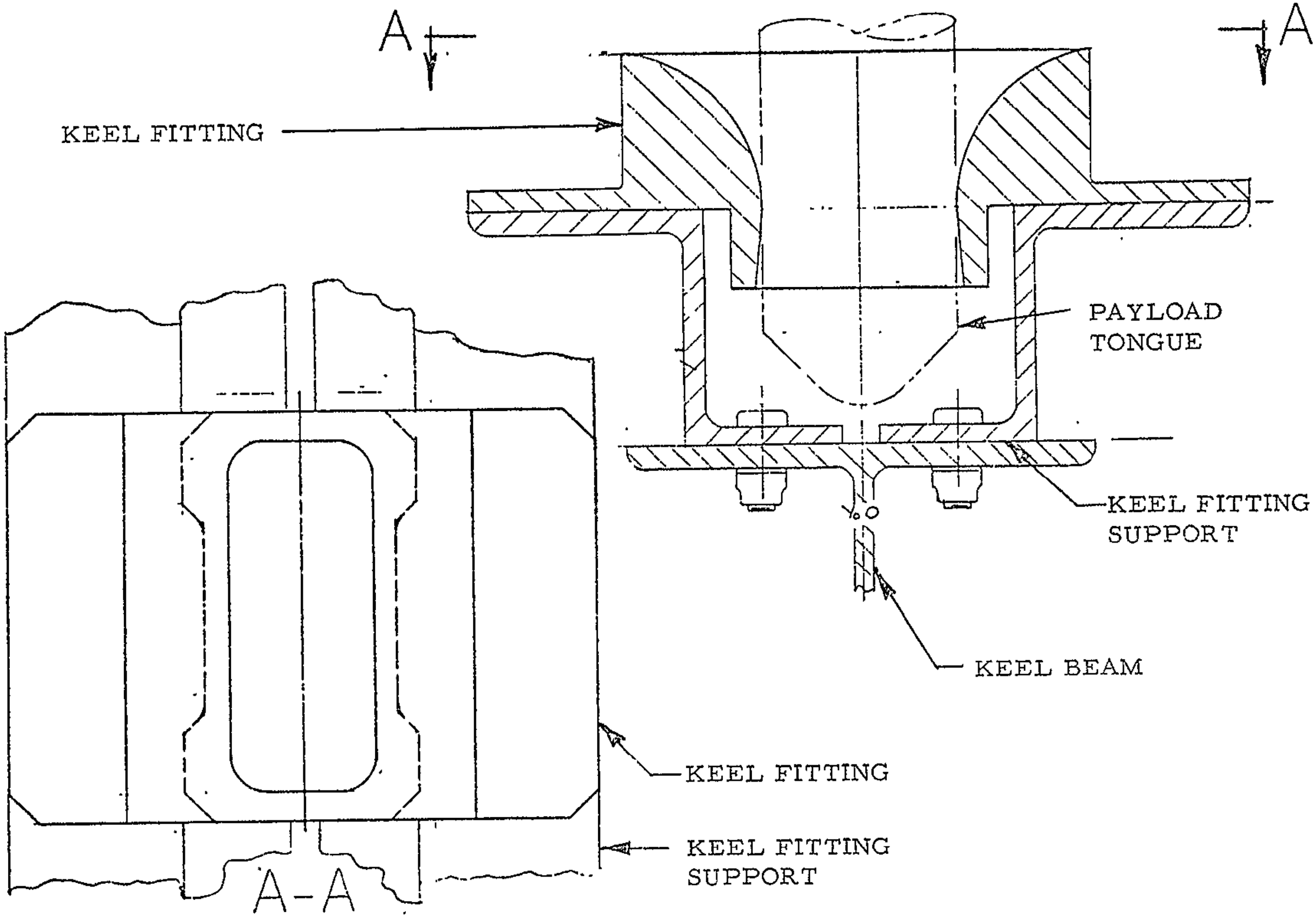

FIGURE 7-10 AUXILIARY KEEL FITTING

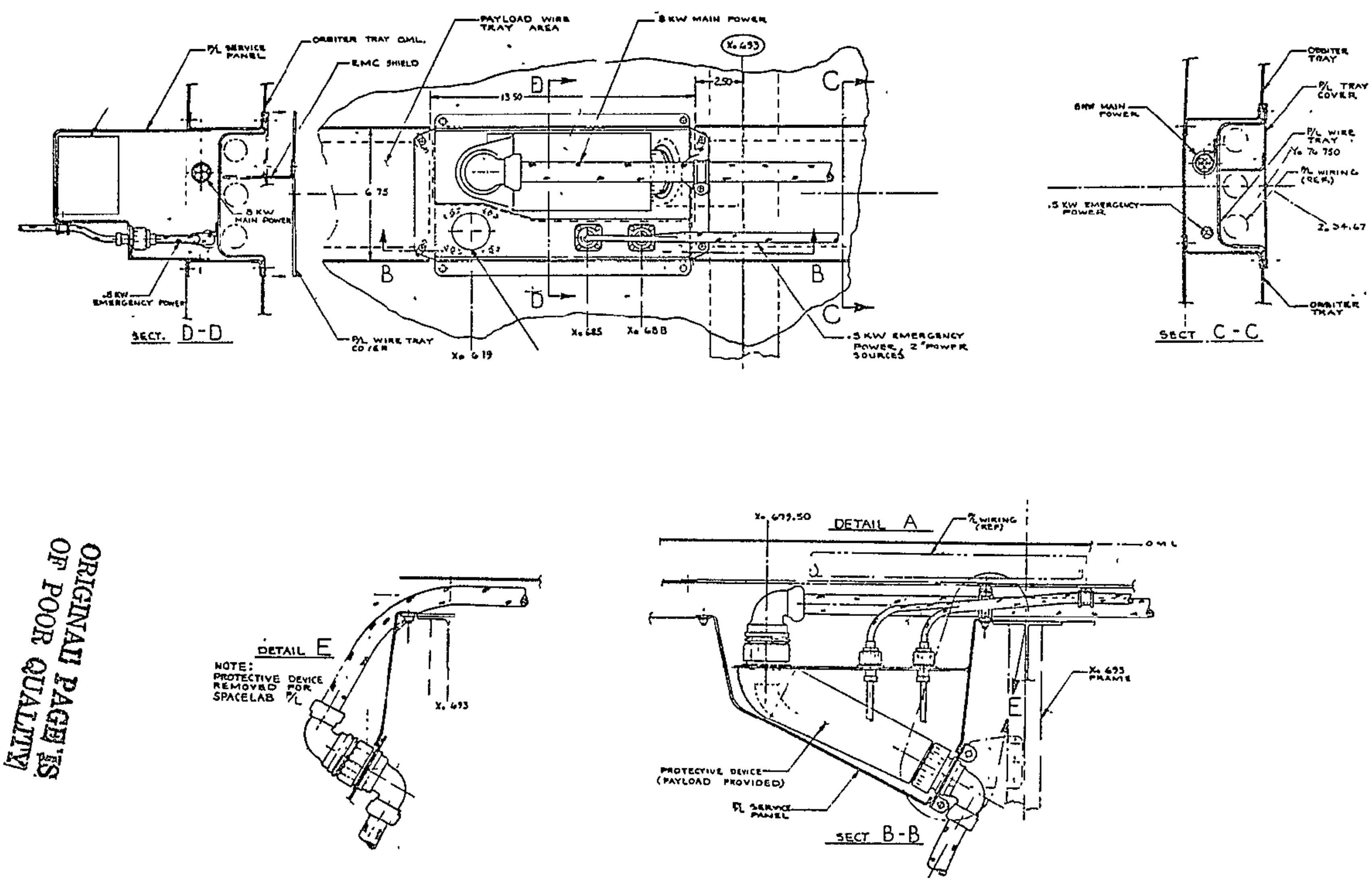

FIGURE 7-11 POWER INTERFACE PANEL

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8.0 STANDARD IVE ELECTRICAL SUBSYSTEMS

8.1 SCOPE

This section establishes the performance, design, and verification requirements for the development of the Standard IVE Electrical Subsystem of the interface verification equipment. The electrical subsystem consists of an operator's console set,aft flight deck set, dc power set, environmental (thermal) control unit set and associated cable sets. The electrical subsystem uses both commercial test hardware and in-house designed/furnished components integrated into an automated interface verification system. (Reference Figure 8-1 for representative layout).

8.2 APPLICABLE DOCUMENTS

See Paragraph 2.0

8.3 REQUIREMENTS

The requirements of Paragraph 3.0 are applicable to this section.

8.3.1 Item Definition

The electrical subsystem shall perform the following functions:

a. Demonstrate Orbiter to Payload signal interface compatibility by simulating the Orbiter to Payload interface.

b. Thruput digital command/data, discretes and analog signals from the payload to the payload support GSE.

c. Provide encoded digital commands and discrete signals as required to the payload subsystems.

d. Perform quantitative data processing of selected analog, discrete and digital payload data. This includes:

   (1) Simulating the Payload related data handling capabilities of the Orbiter communications and data handling (C&DH) system.

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(2) Performing functional testing of the payload (i.e., command the payload and process/strip-out the payload response data).

(3) Simulating the flight computer operating system (FCOS) response to payload data, (timing, etc).

(4) Simulating all payload related data outputs from the FCOS including interleaving of Orbiter and payload data.

(5) Checkout of payload subsystems and on-board payload controls by exercising each of these units through all potential modes they may face during flight.

(6) Provide an interface for simulating payload user uplink/downlink communication to and from the simulated orbiter C&DH system.

e. Provide a test measurement system consisting of commercial measurement equipment for monitoring payload out-of-tolerance signal characteristics.

f. Provide a source of nominal +28vdc bus power for the payload subsystems.

g. Provide a source of 400 hz, 115v ac to payload Display and Control (D&C) equipment in payload station.

h. Provide cooling for the payload subsystems.

8.3.1.1 Item Block Diagram

Figure 8-2 is a representative block diagram of the electrical subsystem.

8.3.1.1.1 Item Description

The electrical subsystem shall consist of four major subsystems.

8.3.1.1.1.1 Operators Console Set Content

8.3.1.1.1.1.1 Input/Output Unit

a. Controller/central processor unit (C/CPU)

b. Memory - 64k words

c. CRT/keyboard

d. Disk Drive

e. Magnetic tape drive

f. Card reader

g. Line printer

h. Paper tape reader

i. Data bus I/F units

8.3.1.1.1.1.2 Test Measurement Unit

a. Digital voltmeter

b. Waveform analyzer

c. Frequency counter

d. Magnetic tape drive (wideband PCM/analog)

e. Patch panel

f. Test measurement unit input switch and control panel

g. Signal conditioner

h. Tape search unit

i. Data bus I/F units

8.3.1.1.1.1.3 Avionics Interface Element (AIE)

a. Dc power supply (test system power)

b. Caution and warning display and control panel

c. Audio distribution panel

d. CCTV monitor and control panel (optional equipment - part of CCTV assy)

e. Control and display panel (payload related functions)

f. Data processing I/F and stimuli equipment (telemetry and telecommand)

g. Dc power Set - remote control and display panel

h. Environmental Control Unit Set (ECUS) - remote control and display panel.

i. Avionics interface signal conversion module (signal conditioners, formatters decoders)

j. Signal distribution and patch assembly

k. Data bus I/F units

8.3.1.1.1.2 Aft Flight Deck Set Content

Equipments provided with the aft flight deck shall be as shown in Table 8.1.

8.3.1.1.1.3 Dc Power (Fuel Cell Bus) Set Content

a. Dc power supply console

b. Remote control and display panel assembly

8.3.1.1.1.4 Interconnecting Cable Set Content

a. Cable assemblies (facility ground/power, signal, control, etc.)

b. Patch panels

8.3.1.1.2 Operators Console Set Subsystem Description

The representative operator console panel layout is as shown in Figure 8-3. The representative operators console block diagram is as shown in Figure 8-4.

TABLE 8.1 IVE AFT FLIGHT DECK - SET CONTENT

STATION	PANEL NUMBER	DESCRIPTION	REMARKS
ON-ORBIT	A1	Rndz Radar Control & Display Panel	Not Provided
	A2	Mission Timer/Audio Control & Display Panel	
	A3	CCTV Monitors	
	A5	Close Out Panel	
	A6	Flight Control Panel Docking Control & Display Panel	Not Provided Not Provided
	A7	CCTV & Floodlighting Control Panel Provided Only	
	A8	Manipulator Control & Display Panel	Not Provided
PAYLOAD	L9	Audio Control Panel	
	L10 Thru L16	Payload Dedicated	Not Provided

TABLE 8.1 IVE AFT FLIGHT DECK - SET CONTENT (CONT)

STATION	PANEL NUMBER	DESCRIPTION	REMARKS
MISSION	R10	Audio Control Panel	
		Lighting - Floodlights/Integral Control	
	R11	Development Flight Instrumentation	Not Provided
		Bus Control Plan	Not Provided
	R12	Payload Power Control & Display Panel	
		S Band Control & Display Panel	Not Provided
		CRT/Keyboard Panel	
	R13	Caution & Warning Control & Display Panel	
		Payload Network Control & Display Panel	Not Provided
		Communications Controls & Display Panel	Not Provided
	R14	Payload Dedicated Control Panel	Not Provided
	R15	Communications & Tracking Control & Display Panel (Audio & CCTV Control & Display Panel Provided Only)	
	R16	Close Out Panel	
	R17	Close Out Panel	
	R18	Close Out Panel	
	R7	Payload Caution & Warning/Safing Control & Display Panel	

8.3.1.1.2.1 Avionics Interface Element (AIE)

The AIE shall provide the following elements.

8.3.1.1.2.1.1 Distribution Module and Patch Panels

Distributes signals from the aft flight deck to appropriate locations within the operators console and payload support GSE connectors.

8.3.1.1.2.1.2 Signal Conditioning Module

Provides signal conditioning for all data/command signals between the payload and the test stimulus/measurement units. The signal conditioning modules shall provide signal termination, noise suppression, overvoltage protection, signal isolation, and impedance matching.

8.3.1.1.2.1.3 Signal Conversion Modules. Consists of devices for encoding telecommands for use by the payload data handling subsystems and decoding digital data responses from the payload. The devices shall be designed to interface with the C/CPU for control of all I/O functions.

8.3.1.1.2.1.4 Environmental Control Unit Set (ECUS)

The ECUS control and display panel/assembly shall consist of temperature monitor and control, flow monitor and control, and coolant tank level indicator circuitry. Control and monitoring of all ECUS functions shall be by manual inputs from front panel controls or provided by a C/CPU control and monitor subroutine.

8.3.1.1.2.1.5 Dc Power Set Remote Control and Display Panel/Assembly

The dc power set remote control and display assembly shall provide primary and backup control of 28 vdc power to the payload. All functions including start, stop, dc output on/off, and voltage level adjustment shall be controlled by the operator from the assembly front panel or provided by a C/CPU control and monitor subroutine.

8.3.1.1.2.1.6 Dc Power (Test System Logic) Unit

The test subsystem shall acquire all dc power from a dc power supply located within the operator's console. The power supply shall have remote control capability.

8.3.1.1.2.1.7 <u>CCTV Monitor and Control Panel</u>

The CCTV monitor and control panel shall consist of a TV monitor, switches and indicators, video amplifier, pattern generator, and signal conditioning and distribution modules for transmitting closed circuit video signals to the payload. Closed circuit video from the payload will also be accepted by the operator console video system for display and test.

8.3.1.1.2.1.8 <u>Audio Distribution Panel</u>

The audio distribution panel shall consist of a speaker, headset jack, switches and indicators, audio amplifier, tone generator and signal conditioning and distribution modules for transmitting audio signals to/from the payload and remote intercom stations.

8.3.1.1.2.2 <u>Test Measurement Unit (TMU)</u>

The TMU shall consist of the following elements necessary for measurement of the payload response channels:

a. TMU input switch consisting of single ended, differential, and coxial interface modules and a manually programmable switching device for routing of signals from the measurement bus.

b. Patch panel for routing of signals from the input switch to the measurement devices.

c. Input switch control assembly.

d. Measurement devices consisting of a programmable waveform analyzer, digital volt meter frequency counter and wideband PCM/analog tape recorder. These devices shall have the capability to measure and record all signal characteristics including amplitude, pulse width, rise/fall times and frequency.

Recording capacity shall provide for simultaneous recording of 14 tracks of data (an additional 14 tracks shall be available as optional equipment) with a 2 MHz band width, at a recording speed of 120 IPS. Data shall be capable of being recorded continuously for approximately TBD minutes. Data shall be played back at the same or TBD reduced speeds for later analysis or be played back through an optional PDI simulator interface using an appropriate set of bit synchronizers. Digital data may be recorded at a maximum rate of 60 K bytes/sec not including inter-record gaps.

8.3.1.1.2.3 Input/Output Unit

The I/O unit shall meet the following requirements:

a. Initiate or generate a sequential series of commands to the AIE.

b. Perform data analysis on all digital/analog data from the payload.

c. Provide all control functions to the IVE test system.

d. Provide an interactive interface between the operator, IVE system and payload.

The I/O Unit elements shall meet the following specifications.

8.3.1.1.2.3.1 Controller/Central Processor Unit (C/CPU)

a. Word size: 16

b. Memory cycle time: 800 nanoseconds (200 nanoseconds w/ interleaving)

c. Memory protection

d. Memory allocation: 64K words (16K word increments)

e. 32 bit floating point processor

f. Microprogrammable

g. Input/output transfer rate: 1.2 MWS (16 bit word) - in
700 KWS (16 bit word) - out
(High speed option - 6MWS)

h. Real time clock

i. Memory allocation and protection

j. Operating system: RTOS or SOS

k. Language: basic or Fortran

8.3.1.1.2.3.2 CRT/Keyboard

a. Lines: 24

b. Characters: 80

c. Variable code structure and band rate

d. Local editing

e. Half or full duplex

8.3.1.1.2.3.3 Moving Head Disc Cartridge Drive

a. Word allocation: 1.247 M words

b. Word length: 16 bits

8.3.1.1.2.3.4 Magnetic Tape Drive

a. Tracks: 9

b. IPS: 75

c. BPI: 800

8.3.1.1.2.3.5 Card Reader

a. CPM: 150

8.3.1.1.2.3.6 Line Printer

a. LPM: 300

b. Columns: 132

8.3.1.1.2.3.7 Paper Tape Reader

a. CPS: 300

b. Channels: 8

8.3.1.1.2.3.8 Wiring

All wiring interconnecting cables and harnesses shall be in accordance with SD4-SH-0002A.

8.3.1.1.3 Aft Flight Deck Set

A representative layout of the aft flight deck is shown in Figure 8-5.

8.3.1.1.3.1 Aft Flight Deck Description

A simulated aft flight deck shall be provided for the control of Orbiter and payload related control and display equipment. Figure 8-6 is a representative block diagram of the aft flight deck.

The aft flight deck will consist of the following items:

a. X_o576 bulkhead payload connector panels.

b. MS, PS, OOS electronic enclosures.

c. Patch panels for routing of IVE and payload unique signals between the aft flight deck components, payload, and the operators console.

d. Control & display panels as indicated in Table 8.1

e. Interconnecting wiring. A description of the aft flight deck electrical items is provided in the following paragraphs.

8.3.1.1.3.1.1 Mission Station (MS)

The MS shall consist of a modified commercial electronic enclosure containing dedicated control and display panels for audio, CRT/keyboard, payload power, orbiter/payload caution and warning, interconnecting cables and CCTV controls. Cooling fans shall be provided for circulating air within the electronic enclosure. Close-out panels shall be provided where orbiter components are not included.

8.3.1.1.3.1.2 On-Orbit Station (OOS)

The OOS shall consist of a modified commercial electronic enclosure containing dedicated control and display panels for audio, floodlights, CCTV control, mission timer, interconnecting cabling and CCTV monitors.

Cooling fans shall be provided for circulating air within the electronic enclosure. Close-out panels shall be provided where orbiter components are not included.

8.3.1.1.3.1.3 Payload Station (PS)

The PS shall consist of a modified commercial electronic enclosure, panel space to accommodate the various payload subsystems, and an audio control panel. Cooling fans shall be provided for circulating air within the electronic enclosure.

8.3.1.1.3.1.4 Wiring

All wiring, interconnecting cables and harnesses shall be in accordance with SD74-SH-0002A.

8.3.1.1.3.1.5 Aft Flight Deck Set Dc Power

The IVE Dc power unit shall provide dc power to the aft flight deck payload station for payload use. The types of power available shall be specified in paragraph 8.3.1.2.4 Item XVII.

The dc bus interface shall consist of a single main bus and two auxiliary buses with individual circuit protection against overloads.

8.3.1.1.3.1.6 Aft Flight Deck Set Ac Power

Three phase, four-wire ac power with the characteristics identified in paragraph 8.3.1.2.4 Item XVII shall be provided by inverters located within the aft flight deck.

This power shall be supplied from two inverter sets with individual circuit protection against overloads.

8.3.1.1.4 Dc Power (Fuel Cell Bus) Set

The Dc Power Unit location is presented in Figure 8-1 for reference only.

8.3.1.1.4.1 Dc Power Set Definition

Nominal +28 vdc bus power will be provided by a 400 ampere commercial dc power supply. This power source shall be conditioned to simulate the Fuel Cell characteristics from 0 to 1 Hz over the operational voltage range. Dc power for subsystem test electronics and the C/CPU shall be

provided by an isolated dc power source. The dc power subsystem shall be designed to be controlled by and respond to the C/CPU. A subroutine residing within the C/CPU memory shall provide the necessary algorithms to simulate the Fuel Cell load line characteristics.

8.3.1.1.4.2 Set Configuration

The Dc Power Unit shall consist of a dc Power Supply located as close as possible to the Fuel Cell/Payload Dc Bus interface to meet impedance matching requirements and specifications indicated in paragraph 8.3.1.2.4 Item XVII and a remote control and display panel residing within the Operators Console.

8.3.1.1.4.3 Wiring

All wiring, interconnecting cables and harnesses shall be in accordance with SD74-SH-0002A.

8.3.1.2 Interface Definition

The functional and physical interface requirements between the IVE and the payload-under-test subsystems are defined in the following paragraphs. The interface definition establishes the functional and physical characteristics at the interface.

8.3.1.2.1 Electrical Power Characteristics

The electrical subsystems shall be designed to operate and maintain specified performance from power sources supplying the following nominal ac voltages:

AC voltages: 440/480, 50/60 Hz, 3Ø
4 wire, 20 KVA

8.3.1.2.1.2 Equipment Ground

An accessible and clearly marked ground stud shall be provided on each equipment enclosure for connecting to the facility Equipment Ground (E-Ground) system. The DC resistance between any metal part of the enclosure and the ground stud shall be less than 2 milliohms.

8.3.1.2.1.3 Instrument Ground

An accessible and clearly marked stud shall be provided on electrical

equipment enclosures for connecting to the facility Instrument Ground (I-Ground) system. The I-Ground stud shall be insulated from the enclosure, and shall be used for grounding signal circuits.

8.3.1.2.1.4 Shield Grounding

Overall cable shields shall be grounded through the connector shell to the supporting panel at both ends of the cable. Individual shields for audio frequency (50 KHz) circuits shall be grounded, at one end only, to the same ground reference to which the enclosed circuit is grounded.

8.3.1.2.1.5 Connectors

All electrical connectors shall be located as shown in Figure 8-7. Connectors shall be in accordance with SW-E-0002. Connectors for each of the following interfaces shall be provided TBD pin assignments and applicable interface data for each signal shall be in accordance with Figures 8-7, 8-8 and 8-9.

8.3.1.2.2 Mechanical Interface

8.3.1.2.2.1 Mounting Requirements

The mounting requirements for the Functional IVE are shown in Figures 8-1 and 8-3.

8.3.1.2.3 Cooling Interface

The cooling interface requirements shall conform to GSE console, Standard Document No. TBD.

8.3.1.2.4 Signal Interface Definition

The input/output signal interfaces between the IVE and the payload are shown in Table 8.2.

TABLE 8.2 INPUT/OUTPUT SIGNAL INTERFACE CHARACTERISTICS

	Interface Channel	Signal Rate	Signal Format	Signal Level	Impedance (Ohms)	Input/ Output
I	Audio					
	Page Listen	300Hz to 3KHz	odBm ± 3db		600 ± 10%	Output
	A/A Listen					
	A/G 1 Listen					
	A/G 2 Listen					
	Opn. I'com Listen					
	Exp. I'com Listen					
	A/A Talk					
	A/G 1 Talk					
	A/G 2 Talk					
	Opn. I'com Talk					
	Exp. I'com Talk					
	Page Talk	300KHz to 3KHz	odBm ± 3db		600Hz ± 10%	Input
	Push to Talk	N/A	TBD		TBD	
	Page Key P/L	N/A	TBD		TBD	
	C&W Tone	TBD	TBD		TBD	Output
II	Video					
	Composite	4.5MHz BW	IV P-P ± 10%		75 ± 5	Input
	Uplink	"	"		"	Output
	Sync	"	"		"	Output
	Non-Standard	4.5MHz BW	IV P-P ± 10%		75 ± 5	Input
III	Payload Signal Processor					
	TDM (Command)					
	TDM (CMD/CMD + Voice)	8/40 KBPS	Biø-L ("1") ("0")	6 ± 0.5v-p 0 ± 0.5v-p	71 ± 7	Output
	TDM (Data/Data + Voice)	16/48 KBPS	Biø-L ("1") ("0")	3 to 6v-p 0 ± 0.5v-p	71 ± 7	Input

TABLE 8.2 (CONT)

	Interface Channel	Signal Rate	Signal Format	Signal Level	Impedance (Ohms)	Input/ Output
IV	Payload Data					
	<u>Interleaver</u>					
	Data	64 KBPS	Para. 3.2.1.4.2(e)		TBD	Input
	Sync	64 KBPS			TBD	Input
V	FM Signal <u>Processor</u>					
	Digital	200BPS to 5MBPS	BI-Ø-L		75 ± 10%	Input
	Digital (Encryp)	256 KBPS	BI-Ø-L or NRZ-L		75 ± 10%	Input
	Analog	4.0 MHz (B/W)	TBD		75 ± 10%	Input
VI	Ku-Band <u>Sig. Processor</u>					
	Digital (Uplink)	1 MBPS (Max)	Convolutional (NRZ-L)		71	Output
	Clock	1 MBPS				Output
	Digital (W/B)	50 MBPS	NRZ-L		71	Input
	Clock	50 MBPS				Input
	"	4 MBPS	NRZ-L		71	Input
	" Clock	4 MBPS				
	"	2 MBPS	BI-Ø-L		71	Input
	Analog	4.2 MHz (B/W)	TBD		71	Input

TABLE 8.2 (CONT)

Interface Channel	Signal Rate	Signal Format	Signal Level	Impedance (Ohms)	Input/ Output
VII MDM					
Serial I/O	1 MBPS	BI-Ø-L,	Half Duplex		
(Data)	("1") +3 to +6v ("0") Minus to Minus 6 TR & TF 60 to 250 NS			Z Source, 83 Max Z Load 75 ± 10%	Input Output
(Msg in, Msg out, word discretes)	("1") +2.4 to +4.5v ("0") Minus 2.4 to Minus 4.5v TR & TF 100 to 1000 NS			Z output 50 (500-3500KHz) Z output 100 (DC-10KHz) Z Load 90 ± 5% in series w/0.01 N+D (140 ft drive cap)	Output
Discrete (DOL)	("1") +5 ±1vdc ("0") 0 ±0.5vdc TR & TF 1.0 to 20.0 NSEC			Source 10ma at 4.0v min Sink 10ma at 0.5v 10K (MDM Pair Off)	Output
Discrete (DOH)	("1") Vehicle Power Voltage w/Allowable 4.5 Internal Drop ("0") 0 to 3vdc may TR & TF 10 to 100 NSEC			Source 10ma at 18vdc 10K (MDM Pair Off)	Output
Discrete (DIH)	("1") 10 to 32vdc ("0") 0 to 6vdc Filter time constant 1.0ms ±12%			245K to 357K	Input
Discrete (DIL)	("1") +5 ±1.0vdc ("0") 0 ±0.5vdc Filter time constant 1.0ms ±12%			14K to 21K	Input
Analog (AID)	Plus 5.11 vdc to Minus 5.12 v			500K(Sampling) 500K(Non-Sampling) 100K(MDM Pwr. Off)	Input

TABLE 8.2 (CONT)

	Interface Channel	Signal Rate	Signal Format	Signal Level	Impedence (Ohms)	Input/ Output
VIII	Discrete	N/A	Switch Closure +28VDC or + 5VDC		100	Input
			Voltage Level Step "ON" 4.0 to 6.0VDC		5K	Input
			Voltage Level Step "OFF" 0.0 to 0.5VDC		5K	Input
			Bias Current - 5HA			
	Analog					
IX	Master Timing Unit					
		4.608 MHz	Square Wave 5 ±1v p-p		75±10%	Output
		1024 KHz	Signal Level 5 ±1v p-p		71±10%	Output
		1 KHz			71±10%	Output
		100 Hz			71±10%	Output
	Clock Outputs	Element Rate 100 PPS	IRIG-B 5 ±1v p-p		71±10%	Output
X	Payload Recorder					
	Serial Digital	Up to 1024 KBPS	Digital	3-9v p-p	71 ohms ±5%	Input
	Parallel Digital	Up to 1024 KBPS	Digital	3-9v p-p	71 ohms ±5%	Input
	Parallel Analog	Up to 2MHz B/W	Analog	1v ±dB	71 ohms ±5%	Input
XI	Wide Band Recorder	TBD	TBD		TBD	Input

TABLE 8.2 (CONT)

	Interface Channel	Signal Rate	Signal Format	Signal Level	Impedance (Ohms)	Input/ Output
XII	Computer (P/L) Displays/Controls I/F					
	Mission Unique					
	88 TSP	TBD	TBD		TBD	Input/Output
	88 TP	TBD	TBD		TBD	Input/Output
	4 CX	TBD	TBD		TBD	Input/Output
XIII	PCM M/U					
	Direct Data Bus	1 MBPS	Serial Digital (28 Bit Word)	±12-15v-p TC & TF 150±50NS	70 ±5%	Output
				±1.5 to 15v-p	6K in parallel 2/30pf	Input
XIV	NSP					
	Digital Voice Talk	32 KBPS	TBD	TBD	TBD	Input
	Clk	"	"	"	"	Input
	Listen	"	"	"	"	Output
	Clk	"	"	"	"	Output
	Delta-Mod Timing	64 KBPS	TBD	TBD	TBD	Output
XV.	COMSEC UNIT					
	Monitor	TBD	TBD	TBD	TBD	Output
XVI	Payload Interrogator					
	Telemetry Data	Up to 16 KBPS	NRZ-L	TBD	TBD	Input
	Clk	Up to 16 KBPS		TBD	TBD	Input
	Command	1,2 K-Band	FSK/AM (1,OS) Subcarrier	TBD	TBD	Output

TABLE 8.2 (CONT)

XVII DC Power Requirements (To Payload)

	$X_o 695$	$X_o 1307$	Aft Flight Deck
Voltage:	27 to 32vdc	27 to 32vdc	24 to 32vdc
Ripple :	1.6v p-p	1.6v p-p	1.6v p-p
Power (Primary):	7KW ave/12KW PK	1.5KW ave/2KW PK	750W ave/1KW PK
Emergency :	560W		

AC Power Requirements

Voltage:	115/208 VRMS
Frequency:	400 Hz
Power:	700 W Maximum Continuous/1 KW PK.

8.3.1.3 Item and Major Components Identification

The identification of the Electrical subsystem and its major components shall be as follows:

Nomenclature	Mfr Code Ident No.	Buyer Control No.	Seller Part No.
TBD	TBD	TBD	TBD

8.3.1.4 Buyer Furnished Property

The following items will be supplied by the buyer and shall be incorporated in the IVE.

ELECTRICAL SUBSYSTEM

Nomenclature	Part No.
TBD	TBD

8.3.1.5 Buyer Directed Procurement

The following components shall be provided by the seller for incorporation into the IVE.

ELECTRICAL SUBSYSTEM

Nomenclature	Part No.	Specification No.	Supplier
TBD	TBD	TBD	TBD

8.3.2 Characteristics

8.3.2.1 Performance

The electrical subsystem shall be capable of simulating the Orbiter avionics communication and data handling system (FCOS) through signal conditioning and software control techniques. A source of serial digital signals, telecommands, discrete signals, and dc bus power shall be generated by test hardware and transferred to the output interface for control of the payload.

The electrical subsystem shall be capable of accepting payload responses in the form of serial digital, PCM, and analog data. Payload

signals shall be transferred to the TMU for waveform analysis by commercial test hardware and the input/output unit for data processing.

The electrical subsystem shall verify all signal, command, and power interfaces through a combination of automatic and manual commanded software sequences. Control of all input/output functions is affected by command or data transfers controlled by the controller/central processor unit (C/CPU).

8.3.2.1.1 Useful Life

As a design objective, the useful life of the electrical subsystem shall be as follows:

a. Electrical and electronic - 10,000 hours

During this period, preventive maintenance, repair, or calibration may be accomplished to maintain specified performance.

8.3.2.1.4 Operating Performance

8.3.2.1.4.1 Test Stimulus

The electrical subsystem shall be capable of providing the following test stimulus to the payload:

(a) Audio analog voice plus associated control functions including C&W Tones
(b) Video and sync
(c) Manchester II (BI-Ø-L) TDM serial digital signals
(d) Delta-Mod Digital Voice and Sync
(e) Convolutional or NRZ-L uplink data
FSK/AM Uplink Data
(f) IRIG-B clock outputs (GMT & MET) plus square wave frequency outputs
(g) Discretes 0 or +5vdc
0 or +28vdc
(h) 1 MBPS Serial Ditigal, Half - Duplex

8.3.2.1.4.2 Test Measurement

The electrical subsystem shall be capable of receiving and processing the following signals generated from a payload:

(a) Audio analog voice plus associated control functions
Digital Voice and Sync

(b) Video (standard/non-standard) and sync (4.5 MHz BW)
(c) Manchester II (BI-Ø-L) TLM Serial digital data
(d) Manchester II (BI-Ø-L) TDM Serial digital data
(e) TLM data at a data format specified by Aerospace Data Systems (ADS) X 560-63-2, TLM Working Group Interrange Inst. Group (IRIG-B) 106-73, and Payload Data Interleaver Proc. Spec, MC476-0136.
(f) Encrypted data (format TBD/data rate 246 KBPS)
(g) Analog data 4.2 MHz max.
(h) Discretes 0 or +5vdc to Minus 5.12vdc
Analog Plus 5.11vdc to Minus 5.12vdc
(i) 1 MBPS Serial Digital, Half Duplex

8.3.2.1.4.2.1 Test Functions

Tests to be performed on the Payload Data/Responses by the TMU and data processing system are shown in Table 8.3.

TABLE 8.3 IVE ELECTRICAL TESTING FUNCTIONS

INTERFACE	MONITOR & RECORD	DATA PROCESSING	SIGNAL ANALYSIS	REMARKS
AUDIO	X		X	VOICE CHECK
CCTV	X		X	VIDEO CHECK(VISUAL)
PAYLOAD SIGNAL PROCESSOR	X	X	X	
PAYLOAD DATA INTERLEAVER	X	X	X	
FM SIGNAL PROCESSOR	X	OPTIONAL	X	
KU-BAND SIGNAL PROCESSOR	X	OPTIONAL	X	
PAYLOAD RECORDER	X	OPTIONAL	X	
CAUTION & WARNING	* X		X X	*MONITOR FOR O.O.S.COND
MDM	X	X	X	
PCM-M/U	X	X	X	
MISSION UNIQUE	X		X	

8.3.2.1.5 Major Functional Interfaces

The electrical subsystem shall be capable of simulating the major functional interfaces of the following orbiter subsystems:

(a) Audio distribution system (ADS)
(b) Closed circuit television (CCTV)
(c) Payload signal processor (PSP)
(d) Payload data interleaver (PDI)
(e) FM Signal processor
(f) Network Signal Processor (NSP)
(g) KU-Band signal processor
(h) Payload recorder channel
(i) Caution and Warning channel
(j) MUX/DEMUX channel (MDM)
(k) PCM Master Unit (PCM M/U)
(l) Master timing unit channel (MTU)
(m) Computer (P/L) displays and controls interface
(n) DC power and control (fuel cell output/control)
(o) Payload coolant system control I/F
(p) Air blower system (P/L station-aft flight deck)

8.3.2.1.5.1 Subsystem Interface Channels

The following paragraphs describe the individual input/output channels of the electrical subsystem. The functional elements are representative and do not reflect a baseline design concept.

8.3.2.1.5.1.1. Auto Power Control

The electrical subsystem operator's console shall include a power control assembly (PCA). The PCA shall provide the following functions:

a. Accept and process manual commands from the control console and provide stimulus to the logic dc power unit.

b. Accept and process commands from the C/CPU and provide stimulus to the dc power (fuel cell simulator) unit.

c. Accept and process analog/discrete responses from the logic dc power supply and the dc power unit and provide out-of-tolerance status signals to the caution and warning (C&W) system.

The auto/manual control modules shall employ relay switching techniques

for processing the discrete commands from the control console and C/CPU.

8.3.2.1.5.1.1.1 Power Control Unit Block Diagram

A representative block diagram of the PCA system mechanization is provided in Figure 8-10.

8.3.2.1.5.1.1.2 Electrical Power Characterisitics

The PCA shall operate from the dc control bus of the operator's console.

8.3.2.1.5.1.2 Audio Control Unit

The electrical subsystem audio control unit (ACU) shall provide the following functions necessary for voice processing:

a. Amplification
b. Mixing
c. Isolation
d. Switching
e. Distribution

The ACU shall provide connection points for audio terminal units to provide test stations with controllable audio and switching and distribution units for control of speakers/headsets and microphones.

8.3.2.1.5.1.2.1 Audio Control Unit Block Diagram

A representative block diagram of the ACU system mechanization is provided in Figure 8-11.

8.3.2.1.5.1.2.2 Electrical Power Characteristics

The ACU shall operate from the logic dc power bus of the operator's console.

8.3.2.1.5.1.2.3 Interface Requirements

The ACU shall be capable of operation with the various hardline interfaces shown in Figure 8-11 and is referenced in paragraph 8.3.1.2.4, Item I. Detailed specifications and requirements for the electrical subsystem audio interface channels shall be as specified in the audio distribution system procurement specification, MC409-0005.

C. 2

8.3.2.1.5.1.2.4 Audio Distribution System (ADS) Simulation

The ADS functional interface shall be simulated by the single conversion module within the AIE. Signal Conversion Module A3 shall consist of the following devices:

a. Audio amplifier
b. Distribution and switching assembly
c. Tone generator
d. Signal conditioner
e. Remote intercommunication units

8.3.2.1.5.1.3 Deleted

8.3.2.1.5.1.4 Payload Signal Processor Channel (PSP)

The PSP subsystem functional interface shall provide the necessary signal processing functions for the digital communications between the electrical subsystem and payloads. The PSP interface simulation shall:

a. Provide bit synchronization for incoming data that are in the biphase-level format.

b. Provide frame sync decoding and signal dumultiplexing of incoming voicd and telemetry data.

c. Provide digital-to-analog conversion for incoming voice signals (delta demodulation).

d. Accept analog voice from the audio central control unit (ACCU) for delta modulation.

8.3.2.1.5.1.4.1 PSP Channel Block Diagram

A representative block diagram of the PSP system mechanization is provided in Figure 8-12.

8.3.2.1.5.1.4.2 Electrical Power Characteristics

The PSP system shall operate from the dc bus of the operator's console.

8.3.2.1.5.1.4.3 Interface Requirements

The PSP channel shall be capable of operation with the various

hardline interfaces shown on Figure 8-12 and provide/accept the following signals:

a. Input. The PSP channel shall accept 16 KBPS of telemetry data or 48 KBPS of TDM serial digital data consisting of a 16-KBPS telmetry channel and a 32-KBPS voice channel from the payload umbilical.

b. Output. The PSP channel shall provide 8 KBPS of command data or 40 KBPS of TDM serial digital data consisting of an 8-KBPS command channel to the payload umbilical (attached payload).

8.3.2.1.5.4.4 Mode Control Input

The PSP channel shall be capable of operating under three modes; each mode is selected manually by a mode control switch located on the IVE control console. The three modes of operation are:

1. NASA--TDM (voice and data)
2. NASA--TDM (data only)
3. DoD--FDM

Detailed specifications and requirements for the electrical subsystem PSP interface channels shall be as specified in the PSP procurement specification, MC476-0138.

8.3.2.1.5.4.5 PSP Simulation

The PSP functional interface shall be simulated by the C/CPU, software control and signal conversion module A28 shall consist of the following devices:

a. Δ demod for demodulating voice signals from the payload
b. Δ mod for modulating voice signals from the ACU for transmission to the payload
c. Encoder for converting digital data from the system data bus into telecommands for transmission to the payload
d. Decoder for converting telemetry data from the payload into digital data acceptable to the C/CPU for data processing
e. Data bus interface unit

The decoder includes a bit synchronizer, a frame synchronizer, and a word selection unit. Parameter storage is provided external to the C/CPU and is set up via DMA. Control/status information for both

frame synchronizers and the word selection unit is transferred from/to the C/CPU via PCØ/PCI. The bit synchronizer is bit rate tunable and has fixed data formats. Input to the bit synchronizer comes from the programmable patch panel allowing for data acceptance direct from the payload or through playback of recorded data.

8.3.2.1.5.1.5 Payload Data Interleaver (PDI) Channel

The PDI subsystem functional interface shall provide the necessary signal processing functions for up to five attached payloads. The PDI interface simulation shall:

a. Accept data from up to five attached payloads simultaneously.

b. Decommutate and reformat selected payload data for use by the IVE data processing system.

8.3.2.1.5.1.5.1 PDI Channel Block Diagram

A representative block diagram of the PDI system mechanization is provided in Figure 8-13.

8.3.2.1.5.1.5.2 Electrical Power Characteristics

The PDI system shall operate from the dc bus of the operator's console.

8.3.2.1.5.1.3 Interface Requirements

The PDI channel shall be capable of operation with the various hard-line interfaces shown in Figure 8-13 and accept payload signals as described in paragraph 8.3.1.2.4, Item IV.

Detailed specifications and requirements for the electrical subsystem PDI interface channels shall be as specified in the PDI procurement specification, MC476-0136.

8.3.2.1.5.1.5.4 PDI Simulation

The PDI functional interface shall be simulated by the C/CPU, software control and signal conversion modules within the AIE. Signal conversion Module A21 shall consist of the following devices for decoding payload data:

a. Bit synchronizer

b. Decommutator

c. Word selector and switching logic

d. Data bus interface unit

The parameter storage is set up via DMA from the Control/status information for both frame synchronizers and the word selection unit is transferred from/to the C/CPU via PCØ/PCI.

The bit synchronizers are bit rate tunable and have fixed data formats. Input to the bit synchronizers comes from the programmable patch panel allowing for data acceptance direct from the payload or through playback of recorded data.

It shall be impossible to simultaneously take selected data from all five data streams, control the number of words from each stream, which words are needed, and where they are to be stored in the C/CPU memory. Data storage pointer lists shall be kept in memory for ease of program control.

8.3.2.1.5.1.6 <u>FM Signal Processor Channel</u>

The FM signal processor subsystem functional interface shall provide the necessary data through-put functions for processing payload data. The unit shall simulate the following functions fo the Orbiter FM signal processor channel:

a. Signal routing

b. Signal conditioning

c. Impedance matching

d. Operational mode switching

8.3.2.1.5.1.6.1 <u>FM Signal Processor Block Diagram</u>

A representative block diagram of the FM signal processor system mechanization is provided in Figure 8-14.

8.3.2.1.5.1.6.2 <u>Electrical Power Characteristics</u>

The FM signal processor system shall operate from the operator console dc bus.

8.3.2.1.5.1.6.3 Interface Requirements

The FM signal processor channel shall be capable of operation with the various hardline interfaces. Shown in Figure 8-14 and accept payload signals as described in paragraph 8.3.1.2.4, Item V.

Detailed specifications and requirements for the electrical subsystem FM signal processor interface channel shall be as specified in the FM signal processor procurement specifications, MC478-0106, Appendix VI.

8.3.2.1.5.1.6.4 FM Signal Processor Simulation

The FM signal processor functional interface shall be simulated by the C/CPU, software control and signal conversion modules within AIE. Signal Conversion Module A24 shall consist of the following devices for processing payload data:

a. Mode selector

b. Decoder

c. Data bus interface unit

NOTE:

Decoder logic shall be provided for the purpose of reformatting payload data for recording on magnetic tape.

8.3.2.1.5.1.7 Ku-Band Signal Processing Channel

The Ku-band signal processing subsystem functional interface shall provide the necessary data through-put functions for the digital/analog communications between the electrical subsystem and the payload. The Ku-band signal processor interface simulation shall:

a. Provide a 1-MBPS, convolutional encoded, Bl-Ø-L, uplink channel to the payload.

b. Accept 50 MBPS NRZ-L payload data.

c. Accept 2-MBPS (Mode 1) or 4-MBPS (Mode 2) digital data (NRZ) and 4.2-MHz analog data from payload.

Data maybe either playback operational data, or real-time payload data or playback experimental PCM data.

8.3.2.1.5.1.7.1 Ku-Band Signal Processor Block Diagram

A representative block diagram of the Ku-Band signal processor system mechanization is provided in Figure 8-15.

8.3.2.1.5.1.7.2 Electrical Power Characteristics

The Ku-band signal processor system shall operate from the operator console dc bus.

8.3.2.1.5.1.7.3 Interface Requirements

The Ku-band signal processor channel shall be capable of operation with various hardline interfaces, shown in Figure 8-15 and accept/provide payload signals as described in paragraph 8.3.1.2.4, Item VI.

Detailed specifications and requirements for the electrical subsystem Ku-band signal processor interface channel shall be as specified in the Ku-band signal processor procurement specification, MC409-0025.

8.3.2.1.5.1.7.4 Ku-Band Signal Processor Simulation

The Ku-Band signal processor functional interface shall be simulated by the C/CPU, software control, and signal conversion modules within the AIE.

Signal Conversion Module A22 shall consist of the following devices for processing payload data

a. 1-MBPS driver/encoder logic for transmission of payload uplink data

b. Receiver/decoder for processing of Mode 1/Mode 2 data from the payload

c. Mode selector

The Ku-Band 1 MBPS uplink logic consists of an NRZ-L driver, a formatter to perform convolutional encoding and to insert data (commands) into the convolutional bit stream, a format program buffer, a command word buffer, and an interface to the C/CPU. The formatter will cause transmission of a continous stream of command information after being started into operation from the C/CPU. Format program and command information for uplink to a payload is transferred from the C/CPU via DMA. Control of uplink operation is via PCØ/PCI.

Note: Decoder logic shall be provided for the purpose of reformatting payload data for recording on magnetic tape.

8.3.2.1.5.1.8 PCM - Master Unit Channel

The PCM-MU interface shall provide for the acquisition of data from up to two payload input/output buses. The PCM-MU interface simulation shall provide the following functions:

a. Operate as a digital data interface between the payload and the IVE data processing system.

8.3.2.1.5.1.8.1 PCM-MU Channel Interconnection Block Diagram

A representative block diagram of the interface between the payload and IVE electrical subsystem is shown in Figure 8-16.

8.3.2.1.5.1.8.2 Electrical Power Characteristics

The PCM-MU interface shall operate from the operator console dc bus.

8.3.2.1.5.1.8.3 Interface Requirements

The PCM-MU channel shall be capable of operation with the various hardline interfaces shown on Figure 8-16 and accept payload signals as described in Paragraph 8.3.1.2.4 Item XIII. Detailed specifications and requirements for the PCM-MU shall be as specified in the PCM-MU procurement specification MC476-0130.

8.3.2.1.5.1.8.4 PCM-MU Simulation

The PCM-MU functional interface shall be simulated by the C/CPU, software control and signal conversion modules within the AIE. The PCM-MU signal conversion module shall contain the following devices for processing data:

- o MIA
- o Control Logic
- o Buffer
- o Decoders

8.3.2.1.5.1.9 Payload MS-PCM Recorder

The Payload recorder functional interface shall provide the necessary data through-put functions for recording payload digital/analog

data. The payload recorder channel interface simulation shall:

(a) Accept 2 serial digital data channels from the payload.

(b) Accept 14 parallel digital data channels from the payload.

(c) Accept 14 analog digital data channels from the payload.

The recorder I/F has been designed to permit expansion to allow for recording and playback of all payload data streams, including the 4.0 MHz analog and the 50 MBPS high speed digital data.

8.3.2.1.5.1.9.1 Payload Recorder Channel Block Diagram

A representative block diagram of the Payload recorder system mechanization is provided in Figure 8-17.

8.3.2.1.5.1.9.2 Electrical Power Characteristics

The payload recorder system shall operate from the dc bus of the operator's console.

8.3.2.1.5.1.9.3 Interface Requirements

The payload recorder channel shall be capable of operation with the various hardline interfaces shown in Figure 8-17 and accept payload signals as described in paragraph 8.3.1.2.4, Item IX.

Detailed specifications and requirements for the electrical subsystem recorder channel shall be as specified in the payload recorder procurement specification, GSEFC 74-15032.

8.3.2.1.5.1.9.4 Payload Recorder Channel Simulation

The payload recorder channel functional interface shall be simulated by the C/CPU, software control, and signal conversion modules within the AIE. Signal Conversion Module A19 shall consist of the following devices for processing of payload data:

a. Receiver/decoder logic for reformatting of payload data for recording on magnetic tape.

b. Data bus interface unit.

The basic system includes a 28 channel wideband recorder with electronics supplied for 14 of the 28 record and reproduce heads. Amplifiers and interface units are proposed which will allow direct recording on all

14 tracks in either digital or analog mode. FM circuitry is proposed for one channel only (according to presently known requirements). Provision is made for recording time using either IRIG B or IRIG G formats. A Time Code Reader, programmable from the C/CPU is provided.

Reproduce amplifiers are provided. However, it should be noted that without special deskew logic, synchronization between tracks during playback degrades at a rate directly proportional to the relative speed between record and playback modes. For example data recorded at 120 IPS and played back at 15 IPS would have 8 times the skew during playback. This has several implications.

1. Data playback occurs at the same speed as record.

2. The data from each channel is analyzed independent of the timing of the other channels. Or

3. Synchronization is not required to an accuracy of greater than 128 microseconds for data recorded at 120 IPS and played back at 1/32 speed.

Based upon the above, it is apparent that synchronization and therefore post processing analysis will be somewhat degraded for the higher data rates, using the basic system. It is recommended that the expansion to handle the higher data rates be delayed till just prior to actual need dates.

8.3.2.1.5.1.10 Caution and Warning (C&W) Channel

The C&W subsystem functional interface shall be capable of accepting payload C&W signals. The C&W interface simulation shall:

a. Accept conditioned analog C&W signals.

b. Accept conditioned discrete C&W signals.

c. Provide output signals to the electrical subsystem C&W display system to indicate out-of-tolerance conditions.

d. Provide limit-setting controls and displays at both the mission station and operator's console.

8.3.2.1.5.1.10.1 C&W Channel Block Diagram

A representative block diagram of the C&W system mechanization is provided in Figure 8-18.

8.3.2.1.5.1.10.2 Electrical Power Characteristics

The C&W system shall operate from the dc bus of the operator's console.

8.3.2.1.5.1.10.3 Interface Requirements

The C&W channel shall be capable of operation with the various hardline interfaces shown in Figure 8-18 and accept payload C&W signals as described in paragraph 8.3.1.2.4, Item VIII.

Detailed specifications and requirements for the electrical subsystem C&W channel shall be as specified in the C&W electronic unit and status display procurement specification, MC409-0012.

8.3.2.1.5.1.10.4 C&W Channel Simulation

The C&W channel functional interface shall be simulated by the C/CPU, software control, and signal conversion modules within the AIE. Signal Conversion Module A26 shall consist of the following devices:

a. Limit select control

b. Signal recognizer logic

c. Switching and control logic

d. Data bus interface unit

The Caution and Warning (C&W) subsystem provides a simulation of Orbiter/Payload C&W discrete/analog I/O and high speed A/D and D/A technology is used for efficiency and flexibility.

The proposed subsystem consists of off-the-shelf A/D and D/A modules integrated with a controller. The controller controls A/D conversion, multiplexing, and limit checking. It contains buffering for variable limits. Parameters may be preset from the C/CPU and out of limit condition will cause an interrupt to the C/CPU.

The state of critical discretes is monitored with change of state detection logic. A change of state of any parameter will cause an interrupt to be given to the C/CPU. It shall be possible to select which parameter changes will cause a C&W interrupt. Response time to a discrete change of state will be dependent upon hardware latency (approximately 40 microseconds) plus a variable software latency.

Both payload power and payload thermal control systems may be monitored via the C&W system.

8.3.2.1.5.1.11 Multiplexer/Demultiplexer Channel

The MDM subsystem functional interface shall convert and format data between the electrical subsystem and the payload. The MDM interface simulation shall:

a. Provide serial digital data input/output channels for payload data.

b. Provide a discrete input/output interface for +28/+5 vdc safing commands, and monitor functions.

c. Provide a discrete/analog signal input interface for payload C&W signals.

8.3.2.1.5.1.11.1 MDM Channel Block Diagram

A representative block diagram of the MDM system mechanization is provided in Figure 8-19.

8.3.2.1.5.1.11.2 Electrical Power Characteristics

The MDM system shall operate from the dc bus of the operator's console.

8.3.2.1.5.1.11.3 Interface Requirements

The MDM channels shall be capable of operation with the various hardline interfaces shown in Figure 8-19 and accept/provide Payload signals as described in paragraph 8.3.1.2.4, Item VII.

Detailed specifications and requirements for the electrical subsystem MDM interface channels shall be as specified in the MDM procurement specification, MC615-0004.

8.3.2.1.5.1.1.11.4 MDM Channel Simulation

The MDM functional interface shall be simulated by the C/CPU, software control, TMU, and signal conversion modules within the AIE.

Signal Conversion Module A20 shall consist of the following devices:

a. SIO simulator consisting of control logic, S/P and P/S

convertors, and receiver/driver circuitry

b. Discrete input/output logic and analog input logic

c. Data bus interface unit

The discrete module consists of the following sections.

1. Deskew logic to permit the simultaneous sampling of input states or simultaneous setting of output states.

2. Holding registers for all output states.

3. Modularized 28 volt and 5 volt input and output signal conditioners.

Minimum time to set up or sample 16 bits of discretes is 4.4 microseconds. System software may set timing between samples to duplicate FCOS operation. Final counts on the relative quantities of 28 and 5 volt drivers and receivers will be determined when payload test requirements become more definitized.

The serial I/O module consists of 6 identical serial channels built with modular techniques. Each channel will duplicate standard MDM timing. Each will communicate with a separate data buffer in C/CPU memory using direct memory access techniques. Each channel may be individually controlled by the C/CPU using standard program controlled input/output instructions. Diagnostic hardware capability will be built in.

8.3.2.1.5.1.12 Payload Computer Displays and Controls Interface

The electrical subsystem shall provide a signal interface for thru putting mission unique control and display signals between the payload subsystems and the OOS/MS/PS unit. Provisions for patching all mission unique signal lines into the TMU shall be provided. All generated/received signal characterisitcs shall be as referenced in paragraph 3.1.2.4 (Item XII). Mission unique signals shall consist of the following types:

a. Serial digital
b. Discrete
c. Analog (C&W)

8.3.2.1.5.1.12.1 Flow Diagram

A representative flow diagram showing I/F between the Payload/

operators console/aft flight deck is shown in Figure 8-20.

8.3.2.1.5.1.13 Master Timing Unit (MTU) Channel

The MTU subsystem functional interface shall provide timing information to the payload. The MTU interface simulation shall:

a. Provide GMT/MET (IRIG-B) signals to the payload.

b. Provide serial time code square-wave outputs to the payload.

8.3.2.1.5.1.13.1 MTU Channel Block Diagram

A representative block diagram of the MTU system mechanization is provided in Figure 8-21.

8.3.2.1.5.1.13.2 Electrical Power Characteristics

The MTU system shall operate from the ac/dc bus of the operator's console.

8.3.2.1.5.13.3 Interface Requirements

The MTU channels shall be capable of operation with the various hardline interfaces shown in Figure 8-21 and provide payload timing signals as described in paragraph 8.3.2.1.4, Item IX.

Detailed specifications and requirements for the electrical subsystem MTU channel shall be as specified in the MTU procurement specification, MC456-0051.

8.3.2.1.5.1.13.4 MTU Channel Simulation

The MTU channel functional interface shall be simulated by the C/CPU, software control, TMU, and signal conversion modules in the AIE. Signal Conversion Module A25 shall consist of the following devices:

a. Clock
b. Time code generator
c. Data bus interface unit

The commercial Time Code Generator is modified to generate GMT and MET. A real time programmable count down clock with a resolution of 1 millisecond or 1 microsecond is provided. Standard Orbiter clock rates are provided.

8.3.2.1.5.1.14 DC Power and Control Interface

The electrical subsystem shall provide the primary source of electrical power for operation of the payload-under-test electrical subsystems. Power generation shall be accomplished by converting 50/60 Hz AC facility power to +28 vdc utilizing a commercial DC power supply. The power unit shall be capable of meeting the following requirements.

DC Bus Voltage:	Continosly variable from +24 vdc to 40 vdc
Power Output:	Continous: 2 to 7 kw 15 minutes max: 12 kw
Ripple:	200 mvp-p

8.3.2.1.5.1.14.1 Flow Diagram

A representative flow diagram of the dc power and control interface is shown in Figure 8-22.

8.3.2.1.5.1.15 Fuel Cell Software/Hardware Simulation Definition

Fuel cell low frequency response (0 to 1 Hz) to step input load changes shall be provided by modifying the DC power supply remote programming control loop.

The flow diagram referenced in paragraph 3.2.1.5.1.14.1 illustrates the method to be used.

8.3.2.1.5.1.15.1 Flow Diagram

Figure 8-23 shows a representative concept for control of the dc power unit.

8.3.2.1.5.1.16 Data Bus Interface Unit Definition

The electrical subsystem shall provide an interface device for interconnecting the C/CPU and user subsystems to the data and control lines of the data bus.

The data bus interface unit shall provide the following circuitry and capabilities:

(a) Connects the interface to the data and control lines on the bus.

(b) For passing the interrupt and data channel priority signals along the bus.

(c) Device selection net.

(d) Busy, done and interrupt logic.

(e) Data channel control signal flip-flops.

(f) Statusing counters.

8.3.2.1.5.1.16.1 Data Bus Interface Unit Block Diagram

A representative block diagram of the data bus interface unit is provided on Figure 8-24.

8.3.2.1.5.1.16.2 Electrical Power Characteristics

The data bus interface unit logic shall operate from the operator console dc bus.

8.3.2.1.5.1.17 Data Bus

The electrical subsystem shall provide a data bus for connecting the C/CPU to the user devices. The following is a description of the data bus control and signal lines:

(a) Six device selection lines. Coding selects up to 62 devices.

(b) Sixteen bidirectional data/address lines for transferring data and address information between the processor and the device.

(c) Six buffer control lines for placing either the A, B or C buffer in the device selected on the data lines.

(d) Start - initializes selected device.

(e) Selected done - Generated by device if through accepting/providing data.

(f) Request enable - Allows devices on-line to request program interrupts or data channel access.

(g) Interrupt request - signifies device is waiting for an interrupt to start.

(h) Interrupt priority - Conditions device to accept serial data from processor.

(i) Interrupt acknowledge - Device will place its device code on the data bus if this signal is received Coincident with receiving the interrupt priority signal and the device interrupt request flip-flop is set.

(j) Mask out - Sets up interrupt disable flags in all devices according to mask on the lines.

(k) Eight data channel control lines - (1) conditions devices for reception of data; (2) informs processor that the device is waiting for data.

(l) Overflow - Generated by processor during a data channel cycle when the result exceeds $2^{16} -1$.

(m) IO Reset - Generated (1) during power turn-on; (2) when console reset switch is pressed (3) during processor I/O reset command.

8.3.2.1.5.1.17.1 <u>Data Bus Transmission Line</u>

The data bus will use a cable composed of fifty twisted pairs in a single covering. External bus wires will be terminated at the far end to match the characteristic impedance of the transmission line. Devices shall not be located more than 50 cable feet from the C/CPU.

The transmission line shall accept data rates up to 6.0 (16 BIT) M words/sec.

8.3.2.1.5.1.18 <u>Operator Console Programmable Patch Panel</u>

The electrical subsystem shall provide a programmable patch panel and signal distribution assembly.

This unit is intended to provide the flexibility necessary for the anticipated needs of a payload interface verification operation. The programmable patch panels allow for ease of system reconfiguration and for access to all interface signals. It is intended that a separate patch board be set up for each test configuration. Also, there would be

a separate patch board for diagnostic purposes.

The programmable patch board also permits a simple technique for GSE through-put switching. Each patch panel is broken into the following three sections:

a. Section 1 is wired to the Payload cable connectors.

b. Section 2 is wired to the GSE cable connectors.

c. Section 3 is wired to the IVE electronics.

Thus it is possible to patch from Section 1 to 3 for IVE/Payload tests, from 2 to 3 for GSE/Payload tests, or from 3 to 3 (wrap around) for the self check mode.

This subsystem also includes a patchable variable signal level unit which allows varying the signal amplitude through normal flight operational ranges. A set of manual controls for changing the signal characteristics is provided.

8.3.2.1.6 Interface Protection

8.3.2.1.6.1 Input Circuitry

The electrical subsystem signal receiver (analog, discrete, or digital) shall not be damaged when any input is shorted to signal, power, or chassis ground or when its input lines are tied to common. The signal receiver (analog, discrete, or digital) shall not be damaged when a TBD signal level is applied for an indefinite period of time. During the above conditions all other functional I/O interface signals and electrical subsystem operational characteristics shall not be degraded from the requirements specified herein.

8.3.2.1.6.2 Output Circuitry

The electrical subsystem output circuitry (analog, discrete, or digital) shall not be damaged when any output is shorted to signal, power, or chassis ground or when its output lines are tied to common. The signal output circuitry (analog, discrete, or digital) shall not be damaged when any TBD signal level is applied for an indefinite period to any outputs. During the above conditions all other IVE electrical subsystems signals and operational characteristics shall not be degraded from the requirements specified herein.

8.3.2.1.6.3 Input/Output Function Isolation

The electrical subsystem shall be designed with an input/output isolation capability so that a failure of one I/O function has no adverse effect on any other I/O functions.

8.3.2.1.6.4 Test Article Protection

The electrical subsystem shall be designed so that the failure of an internal subsystem or component shall not damage the payload-under-test. The AIE signal conditioning interface shall be so designed that transient out-of-tolerance conditions or component failures in the test measurement system shall not propagate to the test article.

8.3.2.1.7 Self-Check

8.3.2.1.7.1 Self-Check Provisions

The electrical subsystem shall provide for the self-detection of malfunctions in the C/CPU, memory, I/O devices and all subsystems referred to in paragraph 3.1.1.1.

8.3.2.1.7.2 Fault Detection Capability

The electrical subsystem shall provide the means whereby commands are generated by the command channels, transferred thru the AIE to the payload interface connectors.

The signals shall be routed back to the IVE P/L interface connector via a self-check cable for processing/failure detection by the data management system ("wrap-around" mode).

8.3.2.1.7.3 Self-Check Programs

Self-check programs shall reside within the C/CPU memory for control of the self-check routine. Self-check of the IVE/payload interface shall not be required during on-line testing of the test article. However, failures or out-of-tolerance conditions generated within the electrical subsystem while on-line testing is in progress shall be detectable and a positive indication of a failure shall be read by resident self-check software.

8.3.2.1.8 Operating Modes

8.3.2.1.8.1 Automatic

The electrical subsystem shall have the capability of being completely and automatically programmed and operated from the C/CPU.

8.3.2.1.8.2 Keyboard/Manual

The operator shall have complete control of all programmed parameters, operating characteristics and test routines from front panel manual controls or the keyboard.

8.4 QUALITY ASSURANCE PROVISIONS

The quality assurance provisions of Paragraph 4.0 are applicable to this section.

8.5 PREPARATION FOR DELIVERY

The delivery requirements of Paragraph 5.0 are applicable to this section.

8.6 SOFTWARE

8.6.1 Software Definition

The electrical subsystem shall provide a software system consisting of the programs shown in Figure 8-25. The following paragraphs describe the three basic types of software and are representative only.

8.6.2 System Support Software

The software that will operate the IVE data management system is termed "System Support Software". Specifically, it includes, as a minimum, the software necessary to control the special purpose interface unit handlers, CPU mainframe, man/machine interface and peripheral handlers. "Software Interface Handlers" will be provided to gain as much fidelity as possible when using Flight Simulation Software. These software interface handlers will link the payload user software to the IVE Flight Simulation Software and will deal heavily with HAL/S operators and the FCOS Simulation Software.

In the IVE, the FCOS software/hardware functions will be simulated by commercial data processing equipment (capability provided for functional checkout of the Payload only) and interface with the IVE Data Management System (i.e., real time executive and support software). This software will simulate the Data Processing System of the GPC to a sufficient fidelity (especially timing) to allow Payload Flight Software to be (1) debugged; (2) used to assist in functional checkout of the Payload. This software shall perform the same functions that the FCOS performs in the GPC.

Other support software includes data recording, post processing, display formatting, ground communication control, etc. System support software will be developed by Rockwell International, Space Division.

8.6.3 Test Application Software

Test application software is used to verify and check Payload System interfaces and functional operation of payload subsystems. This consists of the basic software blocks for the IVE system which will allow a user to exercise the IVE without having to know the details of the IVE system. This software permits the user to deal with the IVE as a "Black Box" system by enabling him to operate the IVE by a series of directives with appropriate parameters. This software would be used to satisfy the requirements of payload checking which would include the following:

(a) Payload system/simulated Orbiter interface verification checks.

(b) Payload system performance checks.

(c) Drivers for interfaces to the simulated Orbiter required for special application (e.g. MCDS) interface for training).

Test application software will be developed by Rockwell International, Space Division, with requirements furnished by the User.

8.6.4 Programming Aids

Programming aids shall be provided as part of the IVE software package and will be used to assist the programmer in constructing the software programs. Aids will include assemblers, linkage editors, compilers, etc. The primary programming aid will be the HAL/S compiler and the CPU mainframe assembler. Programming aids will be developed and/or furnished by Rockwell International, Space Division.

8.6.5 Payload Flight Software

This software will be developed by the Payload user. It is that software, generated by the users (experimenters) which will be used to support testing of the payload by the IVE.

8.6.6 System Test Programs

These are the programs to run the payload system performance checks. The programs consist of modules from the test application software plus some added data processing (if required). Program buildup will be unique for each payload as well as for each payload integration level. Program complexity may range from a test of one channel of one experiment to a full test of the entire payload. This software will be developed by the Payload user and will use the basic buildup blocks identified in paragraphs 8.6.2 and 8.6.3.

8.6.7 Software Operation

The software will be designed to cycle in a payload data checking mode. The data/command signals transmitted to the payload will be checked to determine if the data is correct, if not, a notification is given to the system operator. The data sample and test rates will be identical to the rates planned for the flight program/payload data monitor program.

Capability will be provided to transmit commands directly to the payload through the signal conversion modules in the AIE (Avionics I/F Element). These commands can be initiated manually via switches, I/O devices or the software can be automatically step through the complete set of flight computer/payload commands and data transmission. The software will also monitor and record the payload response to the commands by observing the response data from the data handlers. The software design will provide flexibility to accommodate the range of capabilities anticipated for payloads. The software structure will accommodate tabular lookup techniques for observing payload responses to commands. The tabular data will be developed as a function of the payload capability and can be varied as command data requirements are modified. Hardcopy outputs of all test results will be provided by the software program.

8.6.8 Data Management

A representative data management flow diagram is shown in Figures 8-26 and 8-27.

8.6.9 IVE Software Operating System Definition

8.6.9.1 Test Configuration Description

The IVE will provide an operating system which will be used to test Orbiter/Payload interfaces, to verify proper payload reaction to Orbiter commands and monitor payload outputs. The following basic capabilities will be provided by the IVE test software to perform the following functions:

a. Variable and selectable format real time display.

b. Generalized keyboard control of test operations.

c. Selectable recording on magnetic tape of test data.

d. Capability to start and stop test application program execution.

e. The capability to perform an orderly equipment shutdown by test application program or keyboard action.

f. Modular input/output programs which may be selected by test application programmers and invoked by system calls. Not all I/O programs must be loaded for test applications in which they are not required.

g. Control of the individual elements in the AIE for specialized testing. The software will prevent these elements from being exercised in any mode that is not a normal mode of operation for the device.

8.6.9.2 Test Configuration Major Functions

The operating system programs will execute in two major modes of operation.

8.6.9.2.1 Test Application Program Initialization

This function is used to perform the following tasks.

a. Define test application program and input/output variables and their characteristics to the system.

b. Define test application program display formats to the system.

c. Assign values to program variables and constants for test application program initialization.

8.6.9.2.2 On-Line Mode

This function is used to perform the following tasks:

a. Perform actual on-line testing.

b. Request display pages on the CRT.

c. Select/Deselect magnetic tape recording.

d. Start and stop test application program execution.

e. Print test results and intermediate test results on the line printer.

f. Request an orderly shutdown of payload equipment.

The user will have the capability to use any or all of the IVE equipment simultaneously in any one test application program. All sequencing of the input/output system calls to request inputs and outputs from these equipments will, however, be the responsibility of the

test application programmer. The IVE operating system will provide the capability to verify the interface between one payload and the simulated Orbiter interface, (i.e., only one payload may be verified at a time with test application program).

8.6.9.3 Data Processing Equipment Interface

The commercial equipment (CPU Mainframe, CRT/Keyboard, Disc tape drivers, and test equipment) shall not be program controllable by the test application programmer. These equipments may be used only be appropriate operating system initialization or on-line keyboard commands.

The special purpose test equipments (i.e., interval timer, PCM-MU/PDI/PSP simulator, MDM discrete and SIO simulator, C&W simulator, KU-Band and PSP formatter/simulator and Shuttle data bus simulator) shall be program controlled by the test application programmers. Generalized subroutines shall be provided for the test application programmers for performing input/output functions.

8.6.9.4 Test Application Programming Languages

8.6.9.4.1 Level I

Primary function of the IVE operating system programs will be verification of hardware interface between the payloads and the Orbiter. Test application programs shall be written in assembly language, HAL/S or FORTRAN.

Optional compilers shall be provided as follows:

a. HAL/S programs compiled on IBM 360.
b. HAL/S programs compiled on IVE compiler.
c. GOAL programs compiled on off-line compiler.

A compiler shall be provided to compile HAL/S programs directly on the IVE computer.

The Level I IVE operating system shall not provide the capability to completely verify the operational software for the Orbiter flight computer. However, the following capabilities will exist:

a. Test software concepts for use in an operational environment.

b. Sizing estimates for Payload Software functions.

c. Timing estimates for Payload Software functions.

8.6.9.4.2 Level II

This level of checkout will allow the user to be able to verify the operation of particular payloads in a simulated Orbiter environment. All hardware and software will functionally identical (differences in timing may exist and will be identified as the software system develops) to the actual flight software and hardware for all payload related functions.

In the IVE, software that is functionally equivalent to the actual flight software will be developed. This software will provide users with a means, identical as much as possible to flight operations, for payload systems monitoring and management for the preflight, flight and post-flight mission phases. The fidenity of this software system with respect to the FCOS shall be high enough to verify that if Payload Flight Software operates correctly with this system, it will operate correctly with the FCOS and DPS, however, software validation/certification should be performed with a GPC and associated FCOS hardware.

As in the actual Orbiter environment, the IVE software will interface with a simulated MCDS, simulated PL/MDM's, a simulated payload data interleaver (PDI), simulated payload signal processor (PSP's) simulated PCM master units, simulated MTU, and a simulated network signal processor. The mainframe peripherals will be used to simulate Orbiter mass memory functions.

The IVE software will adhere (to the maximum extent possible) to the actual flight configuration formats for MCDS, uplink, and downlink payload operations.

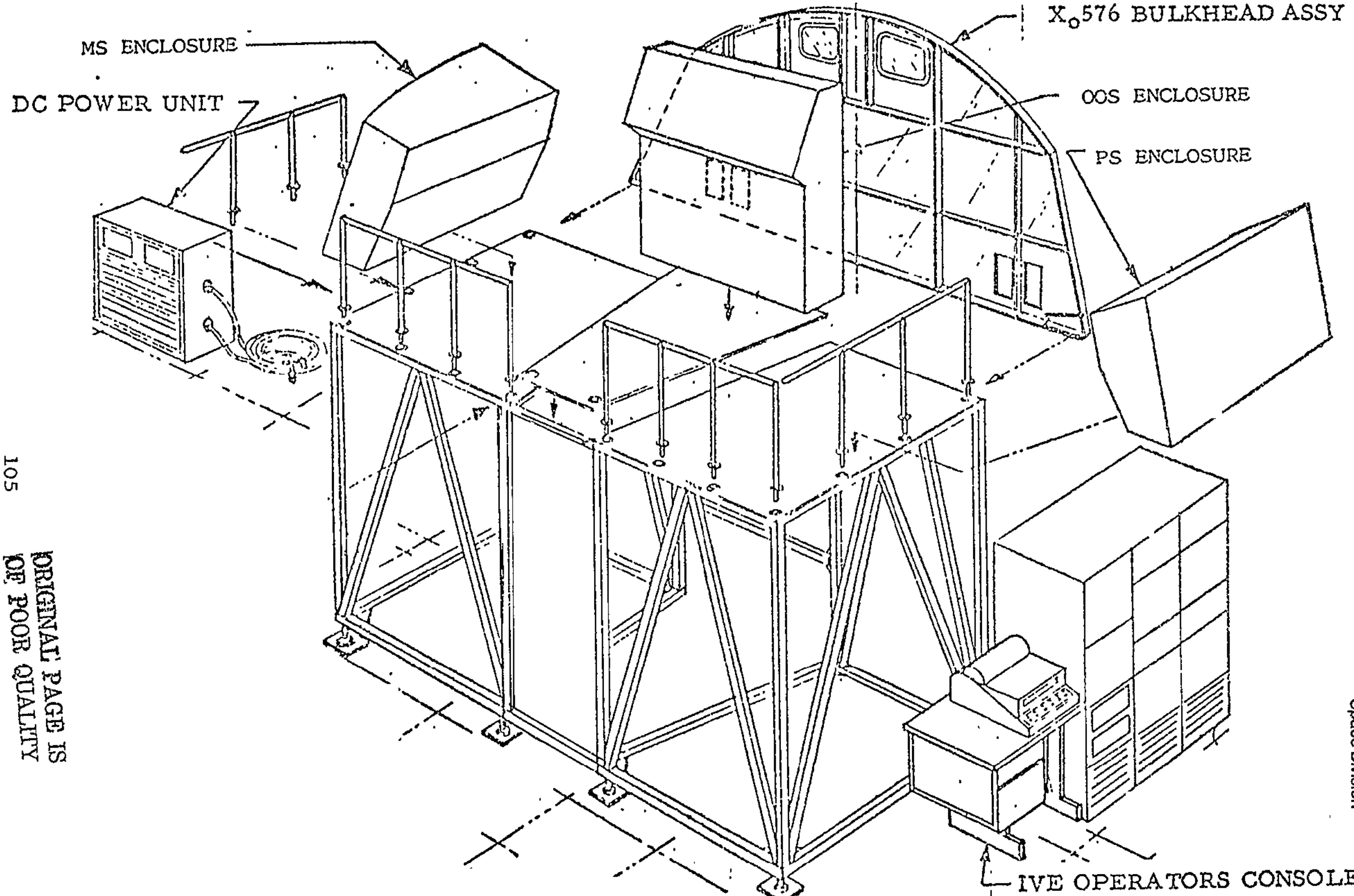

FIGURE 8-1. STANDARD IVE ELECTRICAL SUBSYSTEMS AND AFT FLIGHT DECK CONFIGURATION

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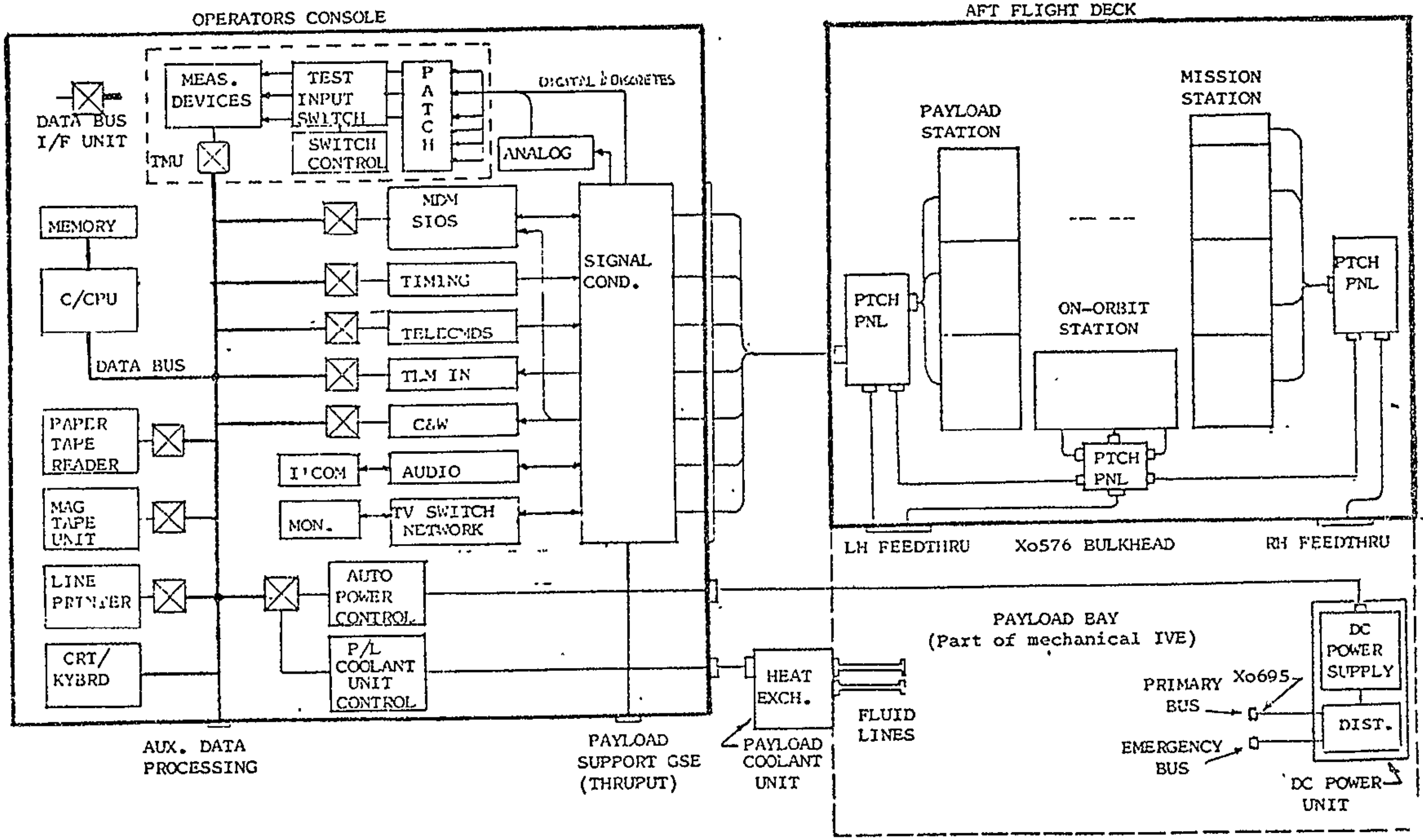


FIGURE 8-2. IVE ELECTRICAL SUBSYSTEM BLOCK DIAGRAM

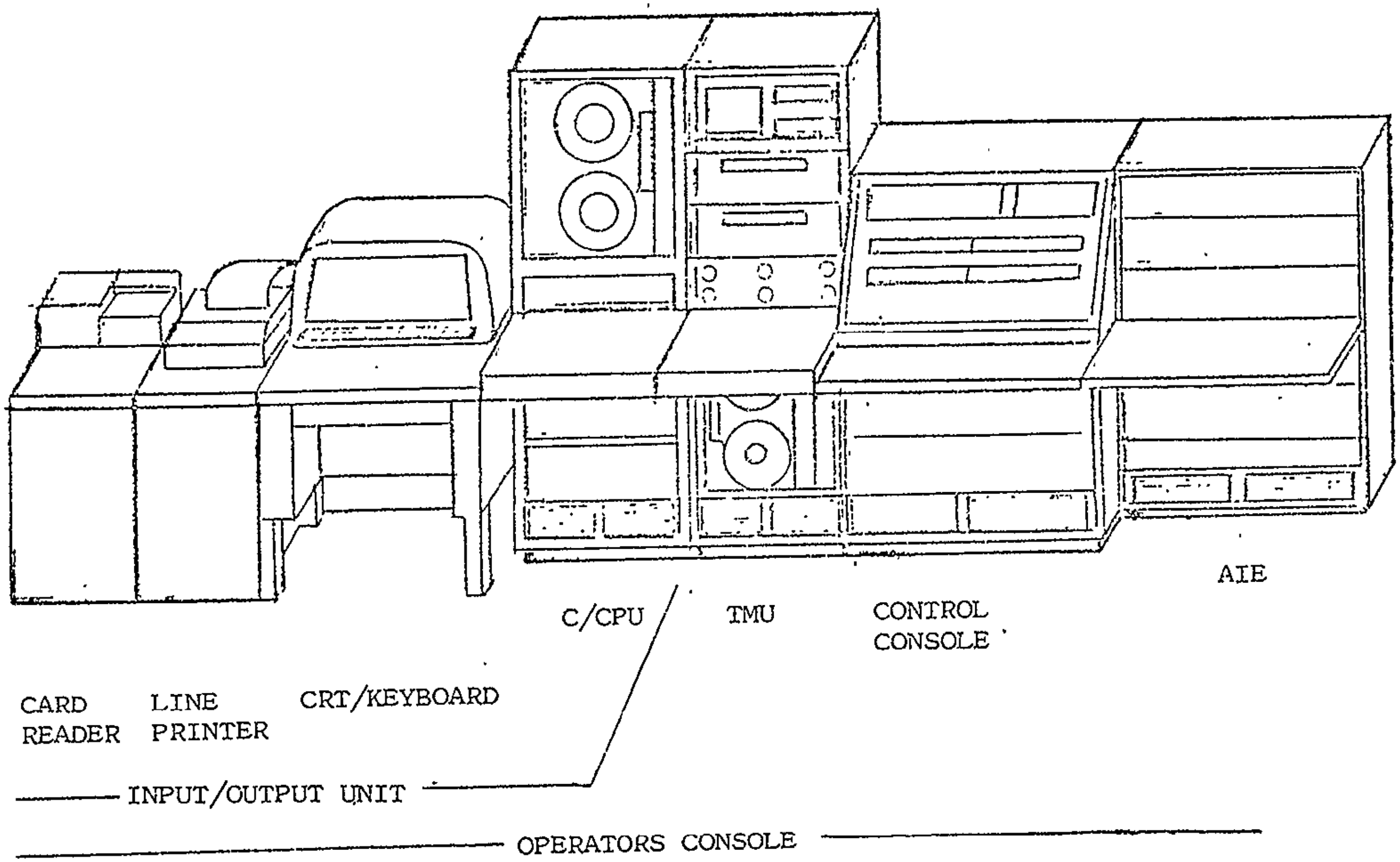


Figure 8-3. OPERATOR CONSOLE-TYPICAL FRONT PANEL LAYOUT

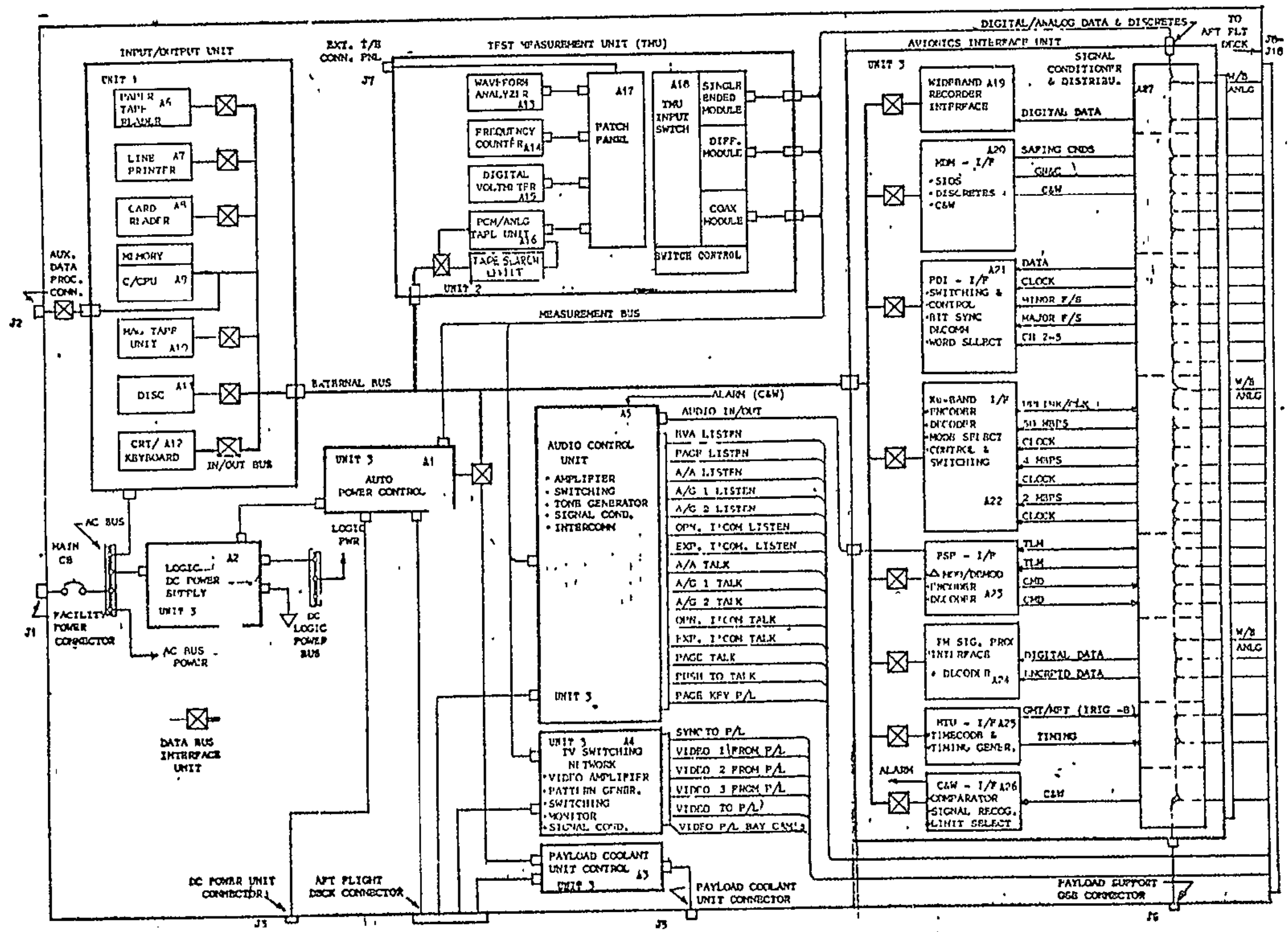


Figure 8-4. OPERATOR CONSOLE BLOCK DIAGRAM

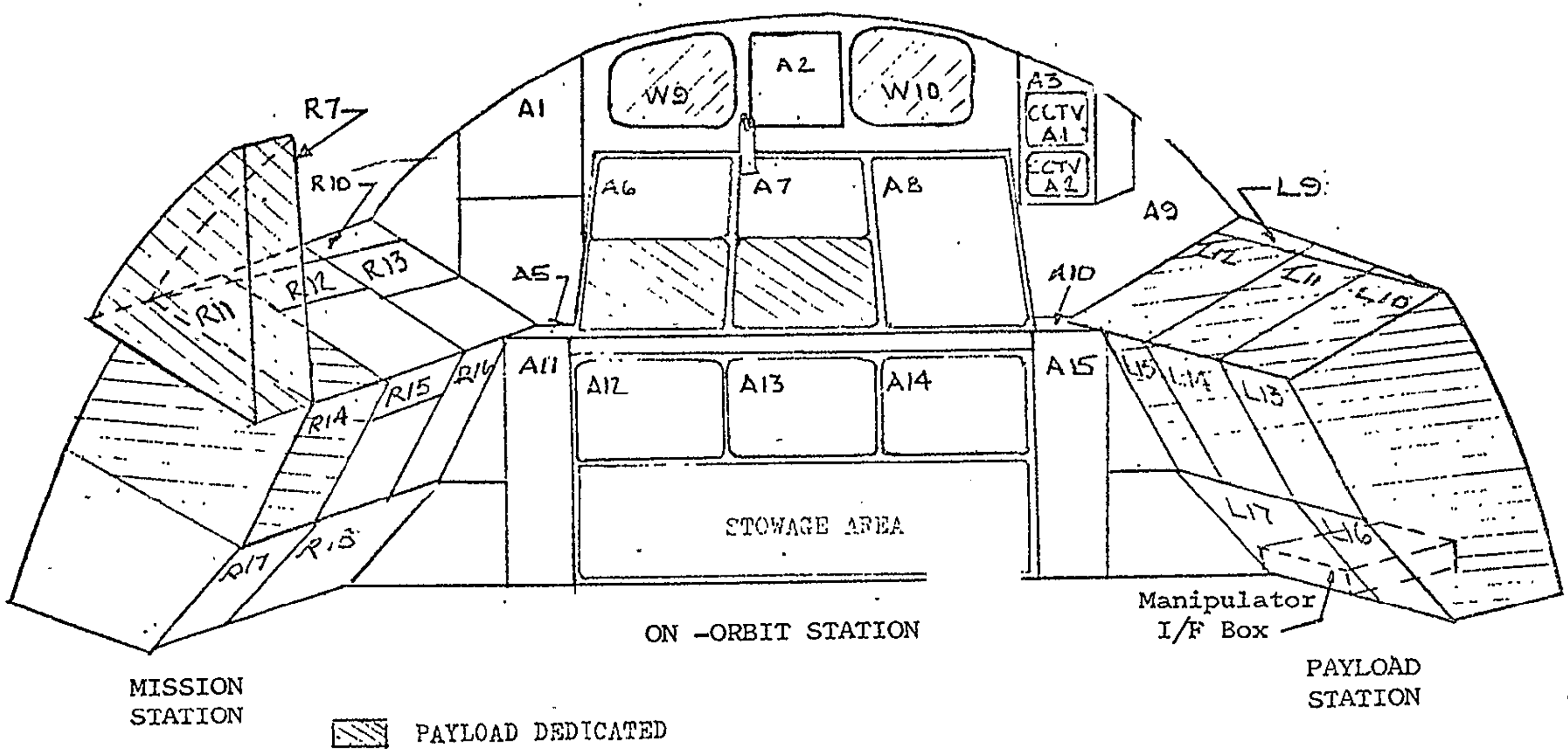
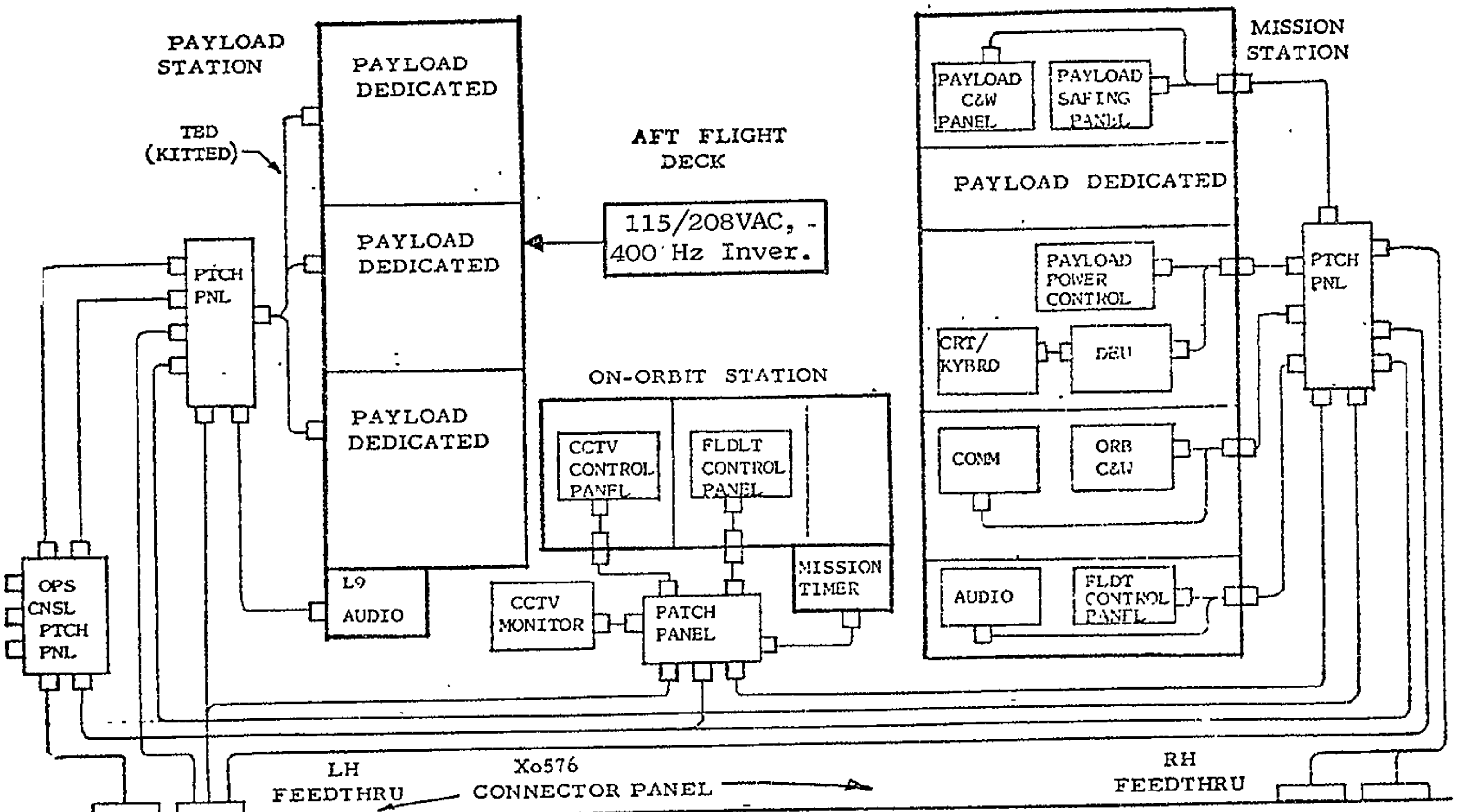


Figure 8-5. LAYOUT - AFT FLIGHT DECK



NOTE: Location of cables, components; etc, are TBD and are representative only.

PAYLOAD

Figure 8-6. IVE AFT FLIGHT DECK BLOCK DIAGRAM

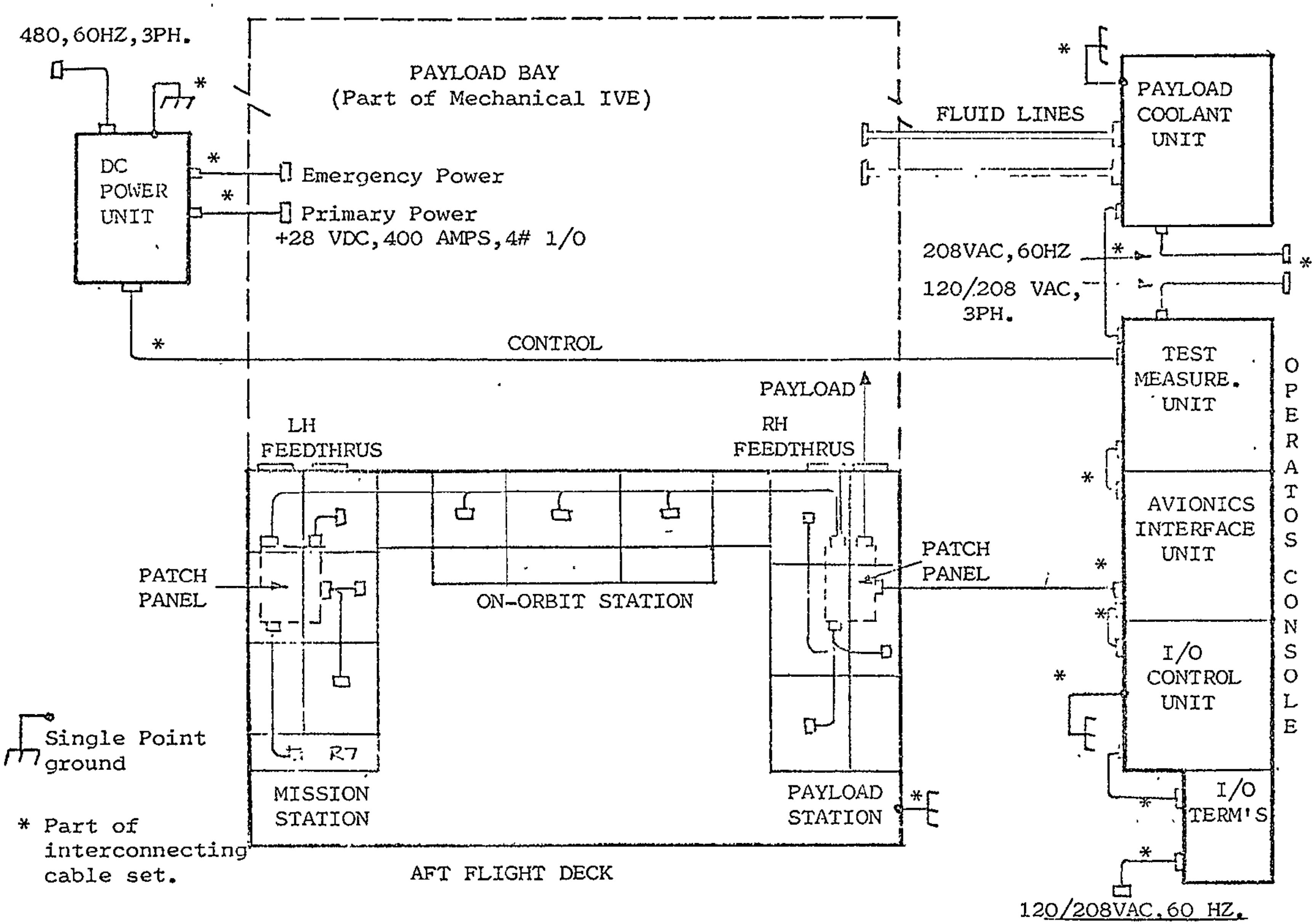


Figure 8-7. IVE ELECTRICAL CABLE INTERCONNECT DIAGRAM

TBD

Figure 8-8. PIN ASSIGNMENTS, SIGNAL DEFINITION AND CONNECTOR ORIENTATION

TBD

Figure 8-9. CABLE SET SPECIFICATION

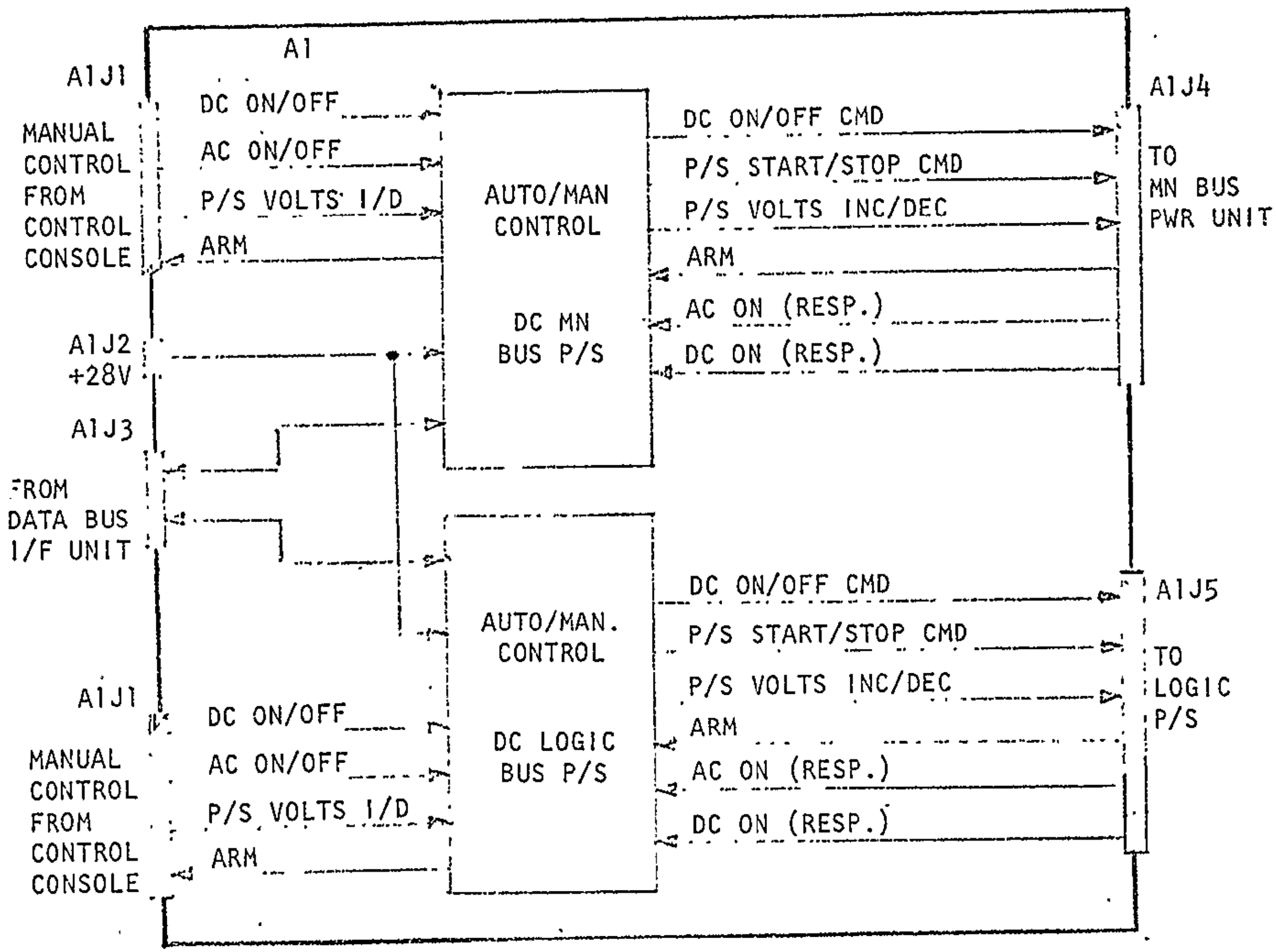


Figure 8-10. A1-AUTO POWER CONTROL ASSEMBLY BLOCK DIAGRAM

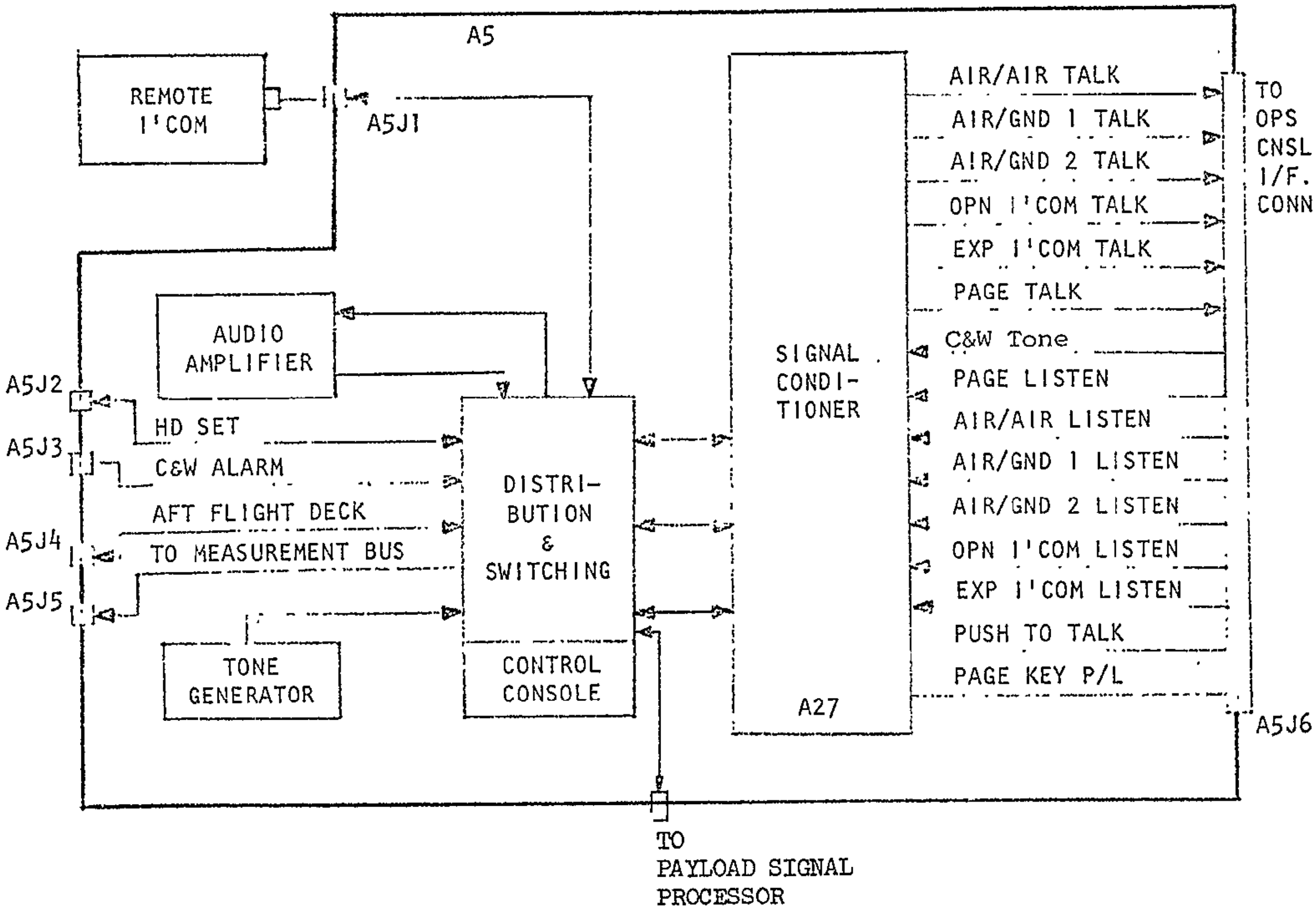


Figure 8-11. A5 - AUDIO CONTROL UNIT BLOCK DIAGRAM

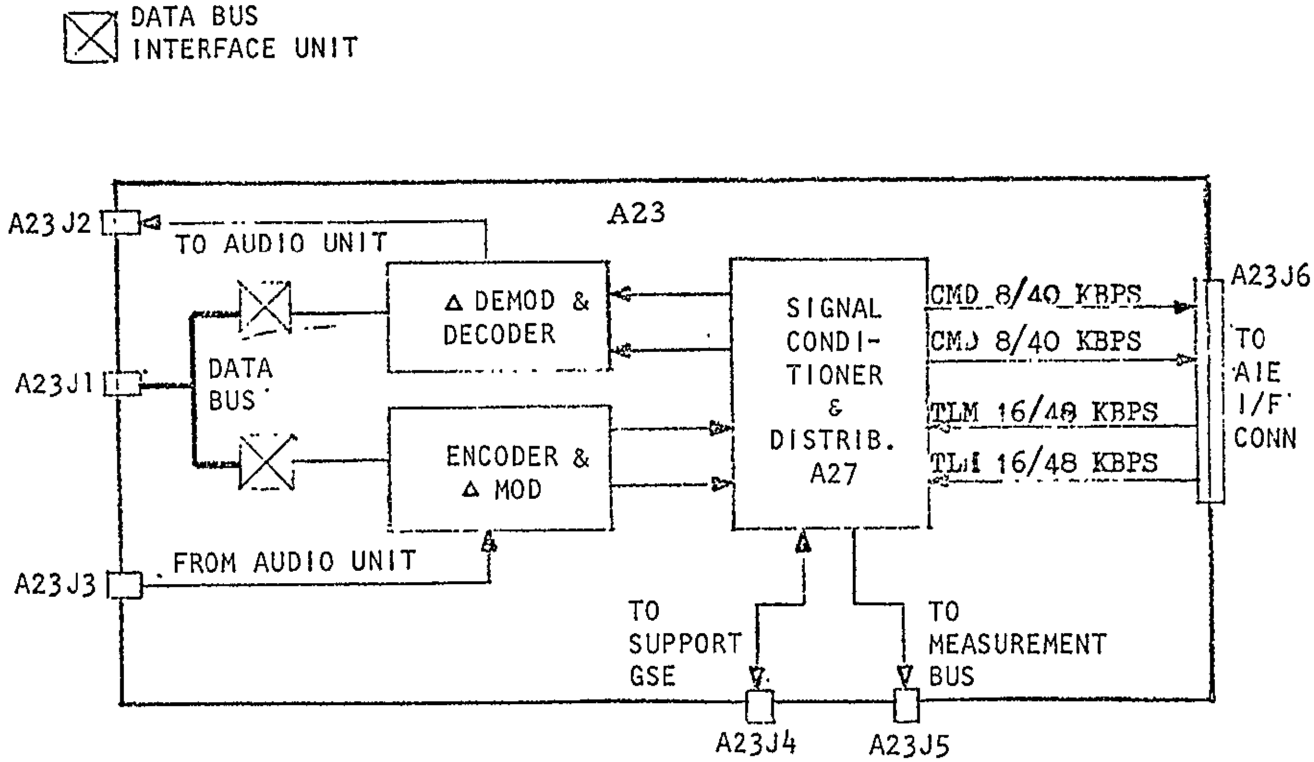


Figure 8-12. A23 - PAYLOAD SIGNAL PROCESSOR INTERFACE BLOCK DIAGRAM

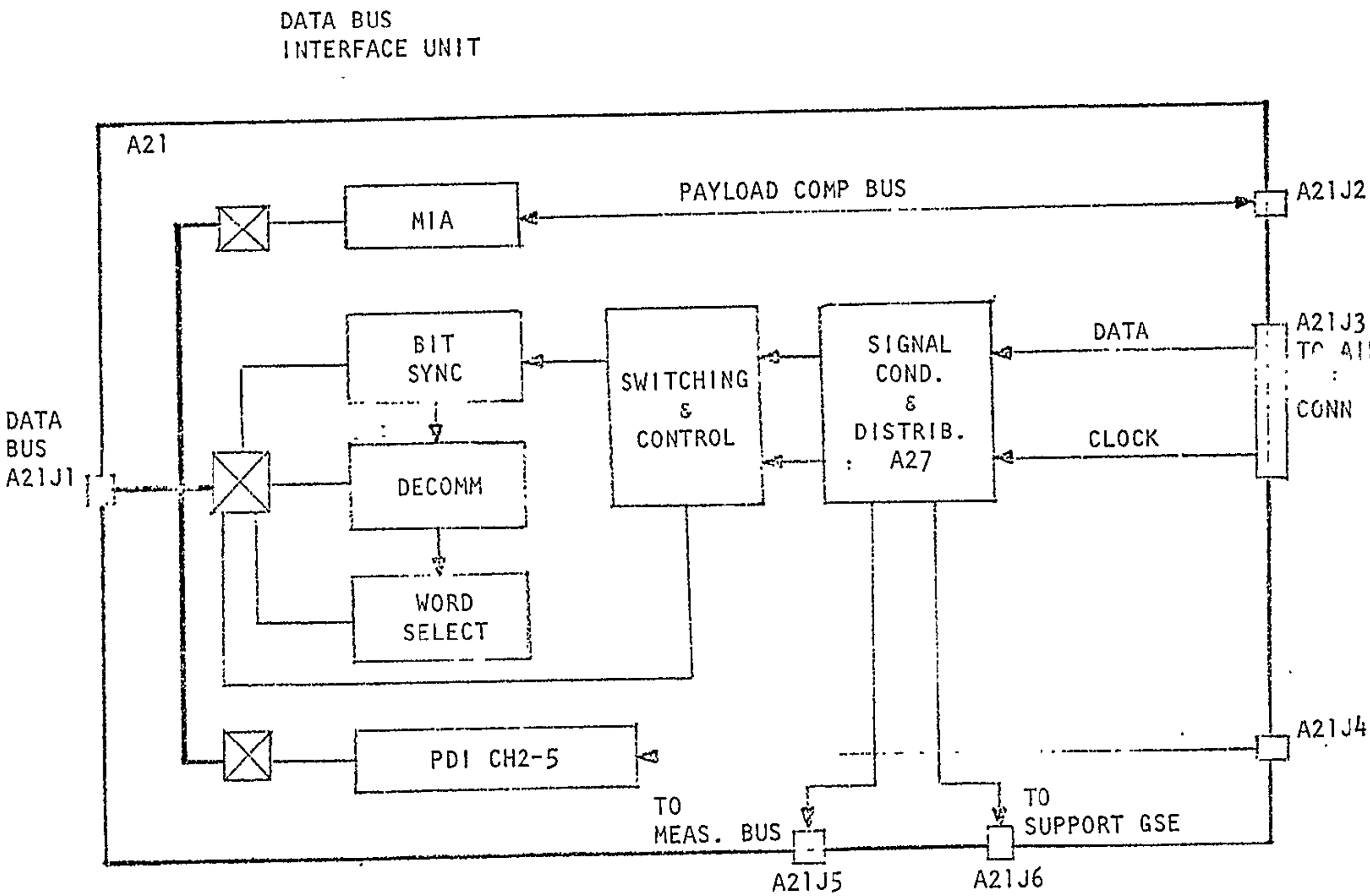


Figure 8-13. A21 - PAYLOAD DATA INTERLEAVER INTERFACE BLOCK DIAGRAM

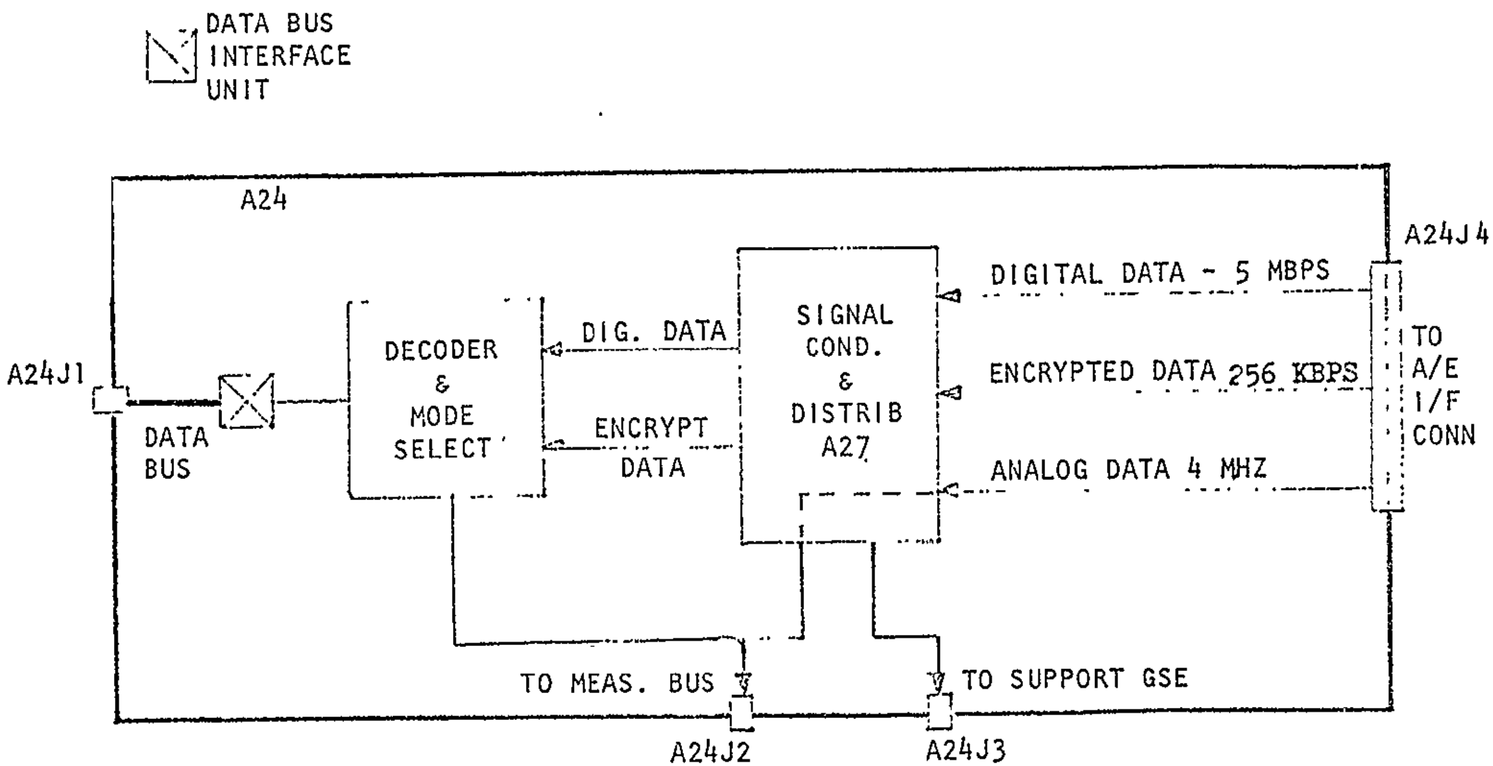


Figure 8-14. A24 - FM SIGNAL PROCESSOR INTERFACE BLOCK DIAGRAM

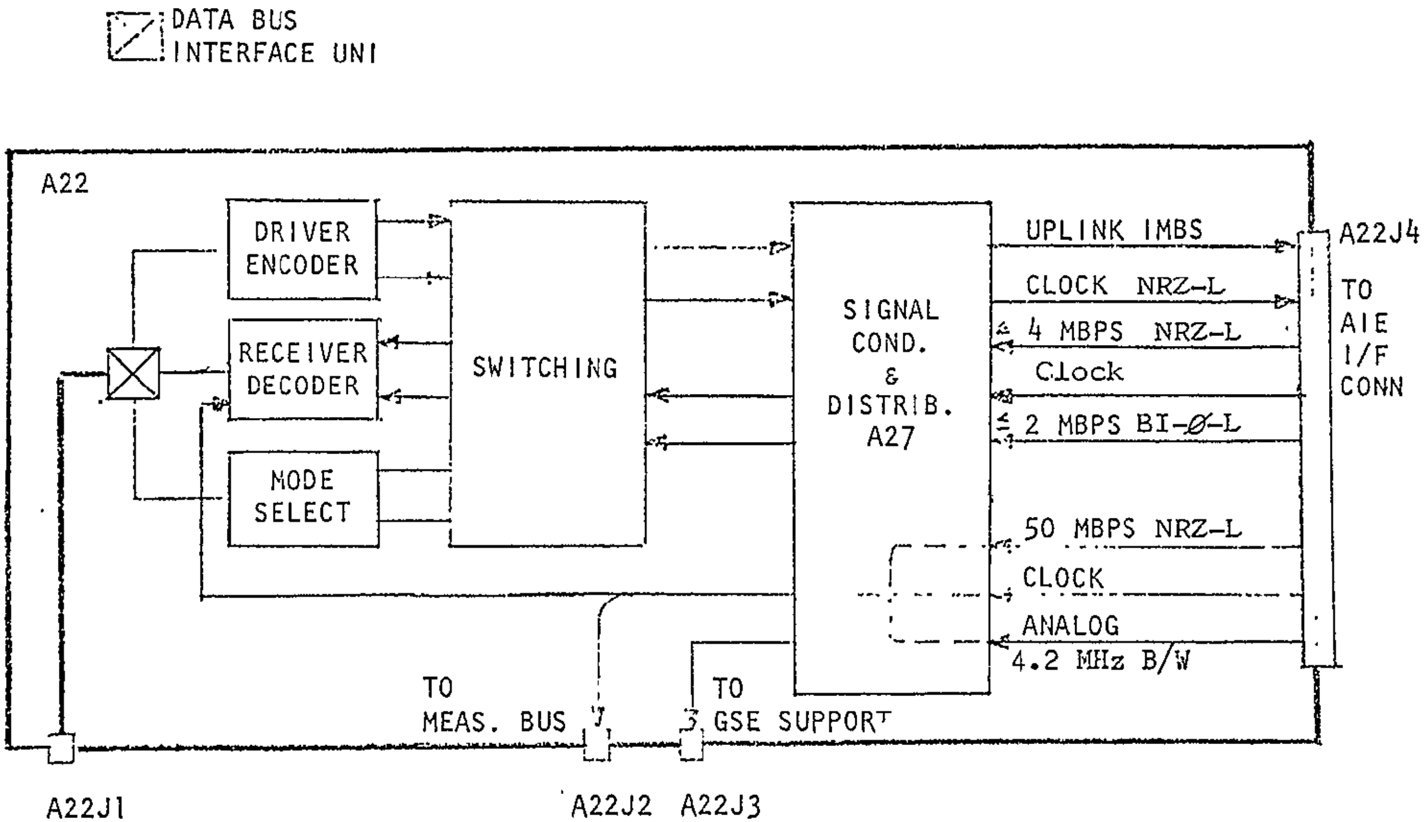


Figure 8-15. A22 - Ku-BAND SIGNAL PROCESSOR INTERFACE BLOCK DIAGRAM

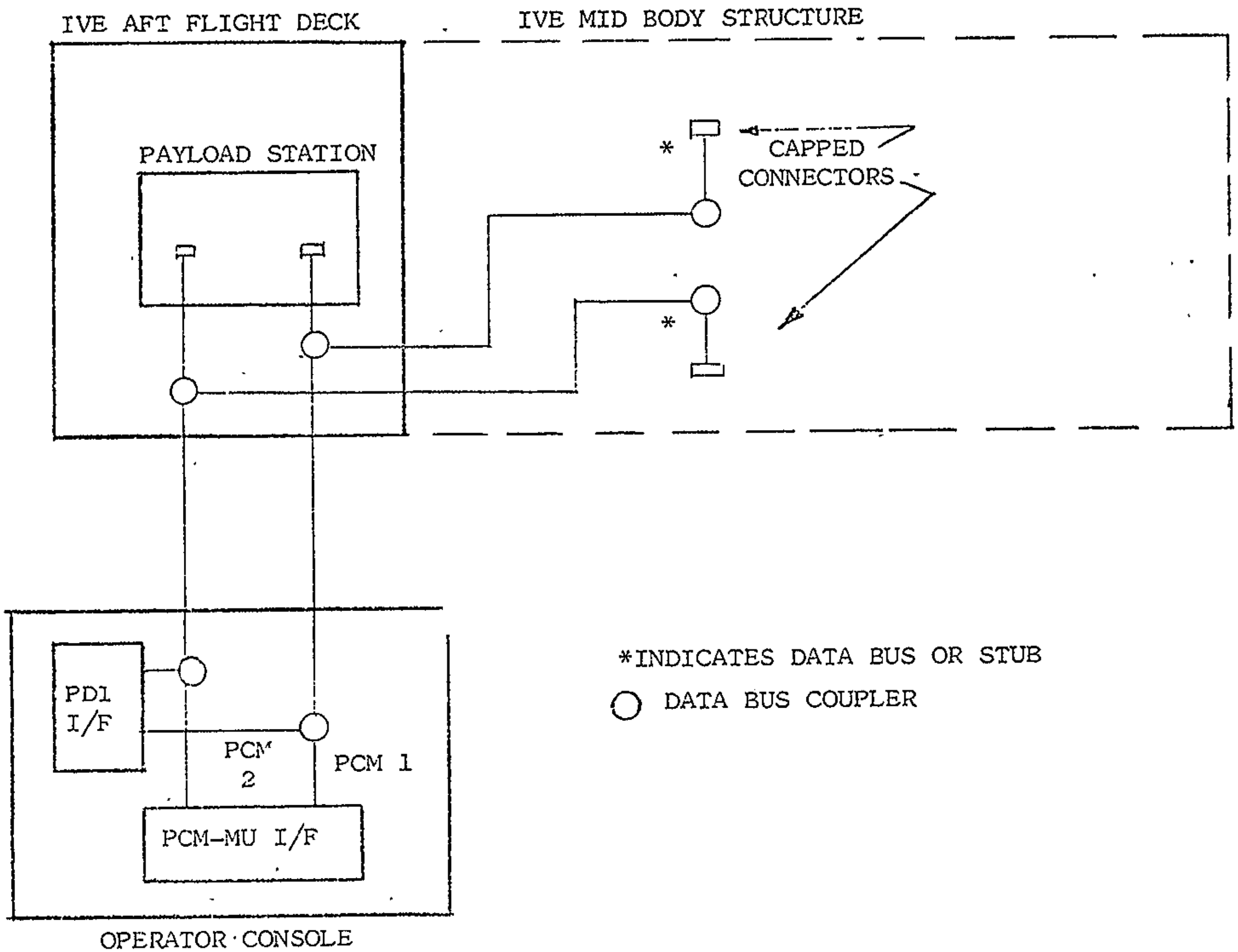


Figure 8-16. PCM-MU INTERFACE BLOCK DIAGRAM

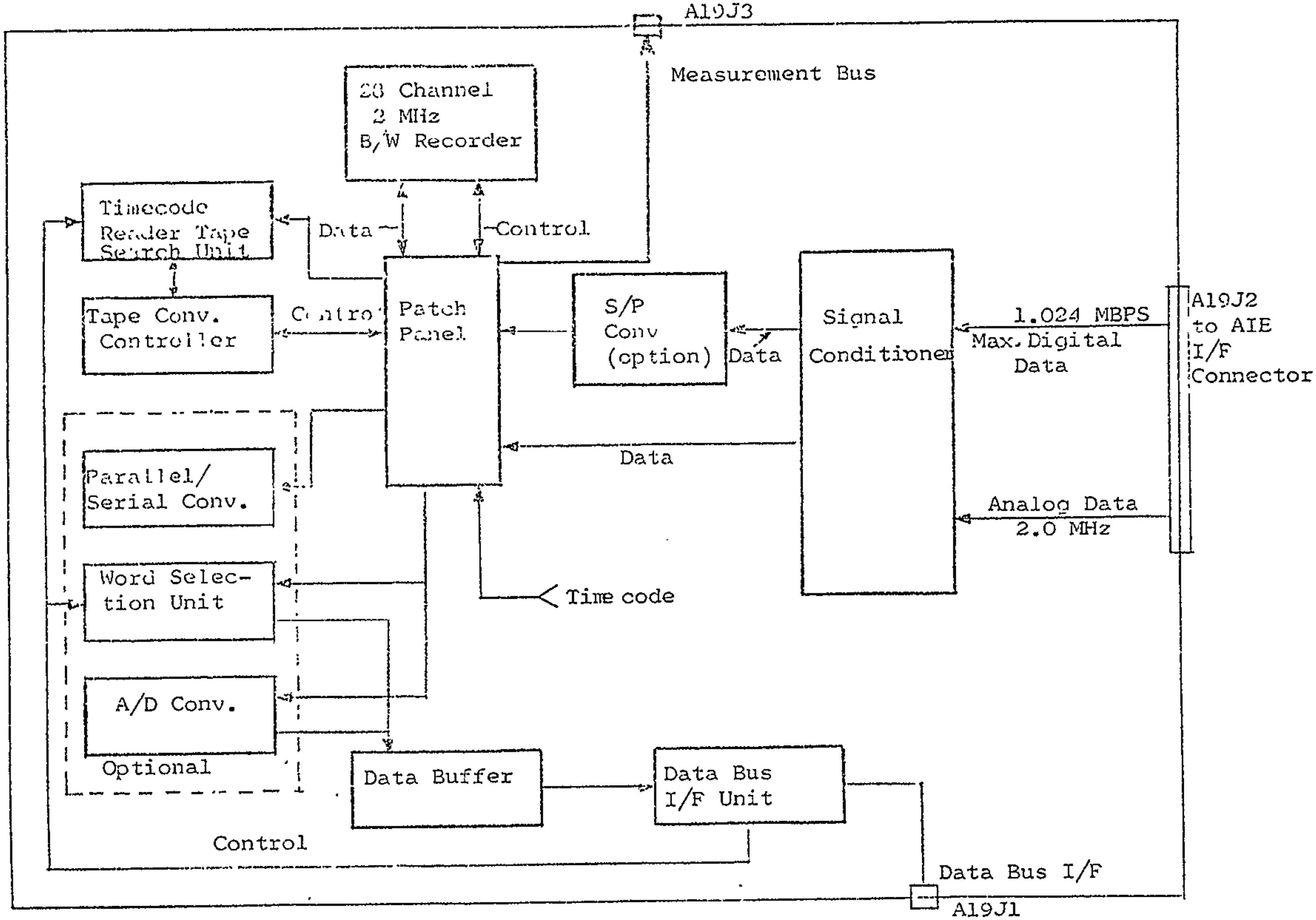


Figure 8-17. A19 - PAYLOAD RECORDER INTERFACE BLOCK DIAGRAM

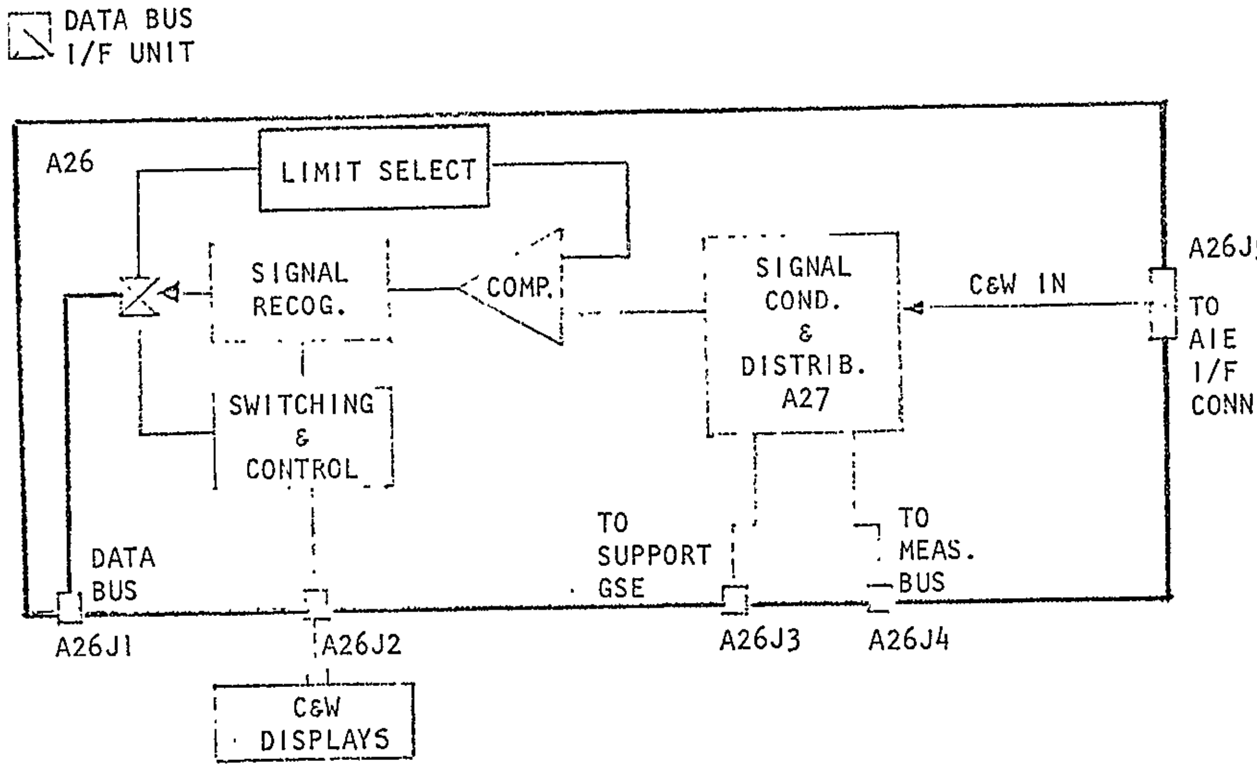


Figure 8-18. A25 - CAUTION & WARNING INTERFACE BLOCK DIAGRAM

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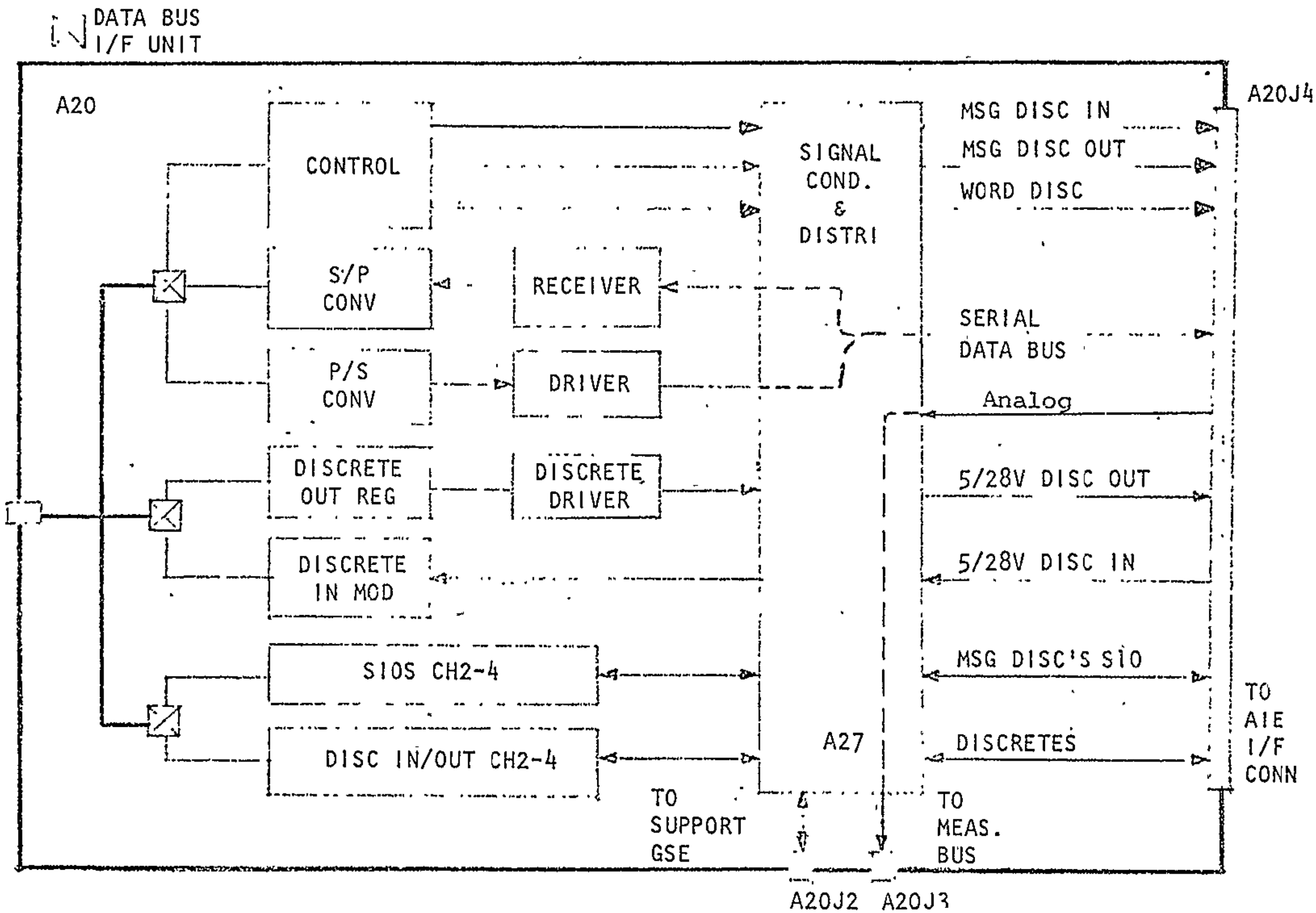

Figure 8-19. A20 - MUX/DEMUX INTERFACE BLOCK DIAGRAM

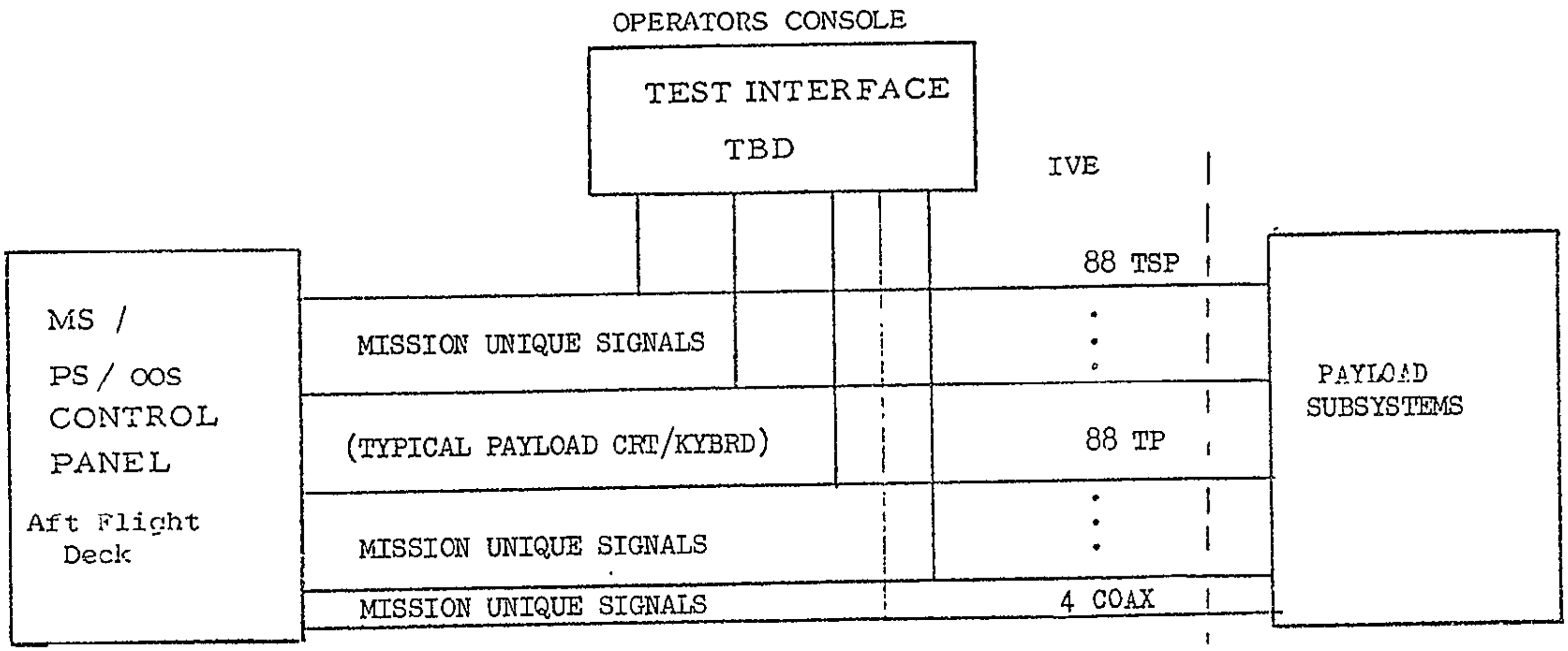

FIGURE 8-20 PAYLOAD MISSION UNIQUE SIGNALS - TEST INTERFACE

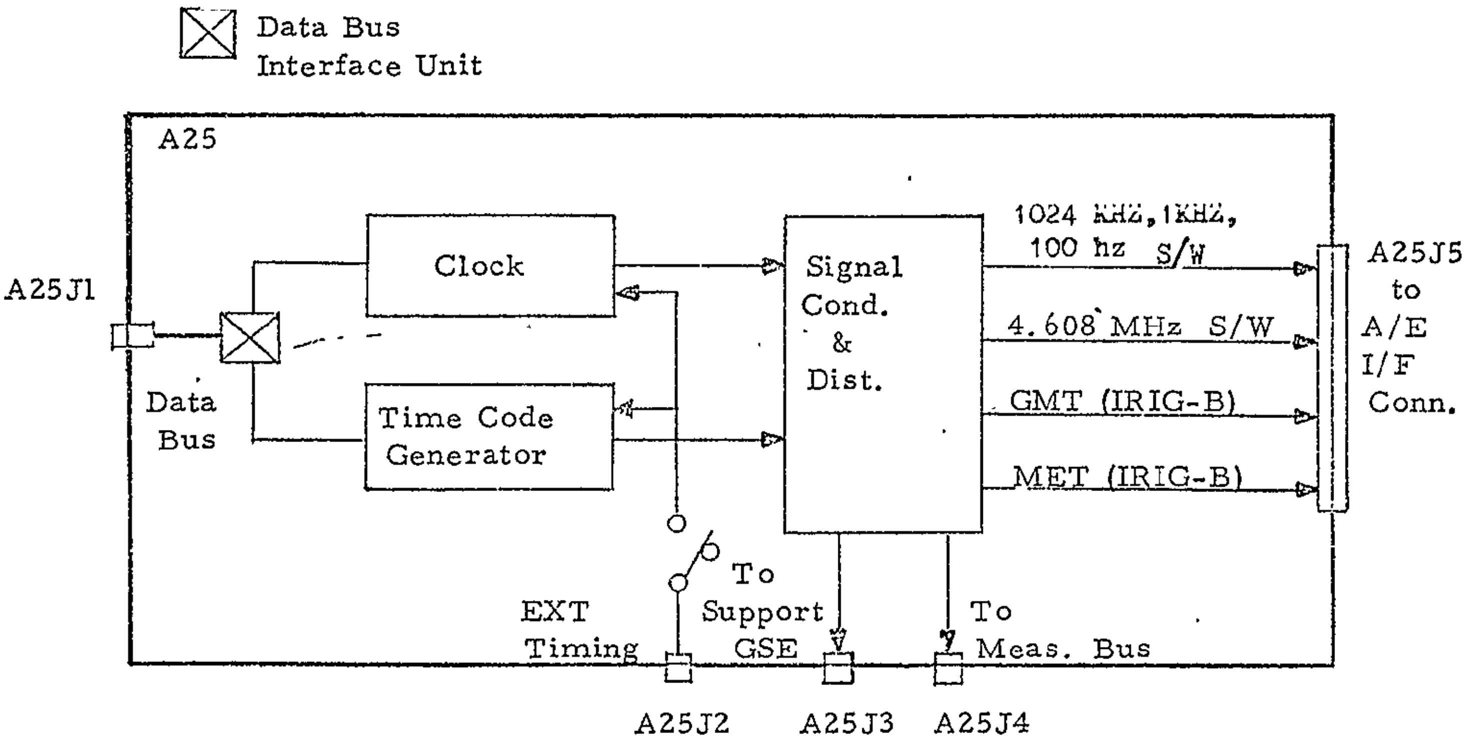

Figure 8-21. A25 - MASTER TIMING UNIT BLOCK DIAGRAM

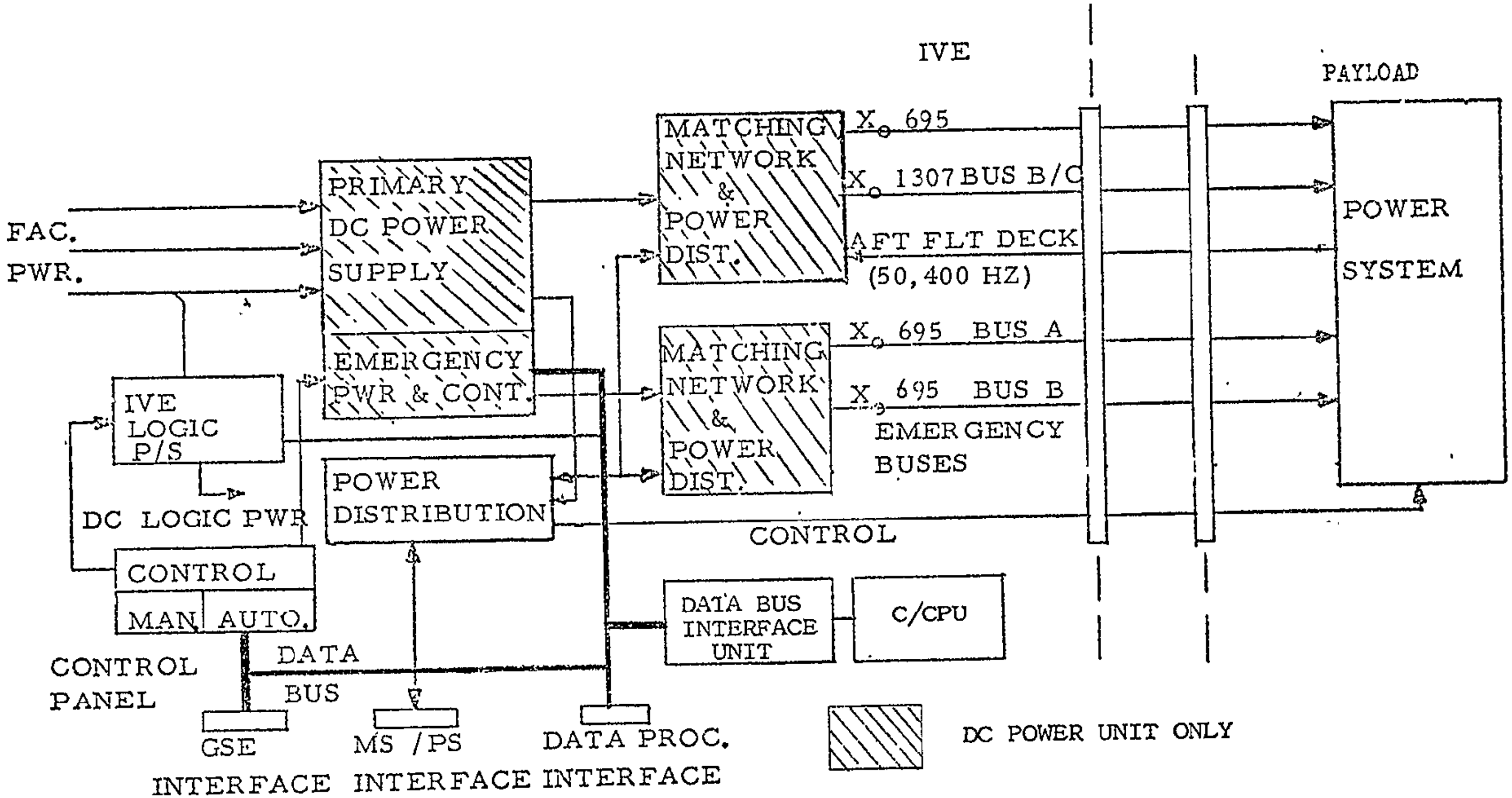

FIGURE 8-22 DC POWER AND CONTROL INTERFACE

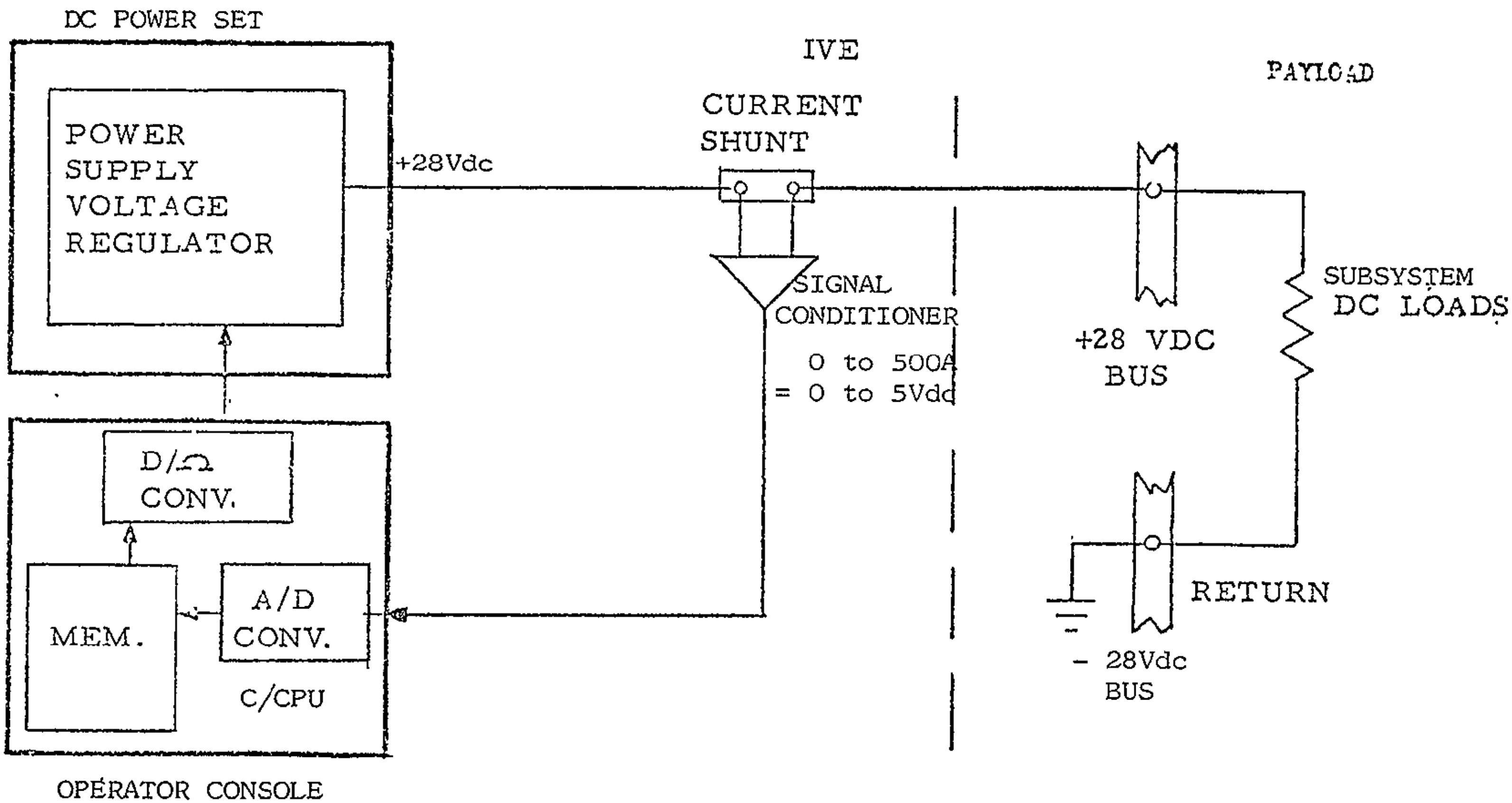

FIGURE 8-23 FUEL CELL SIMULATION - 0 to 1 HZ

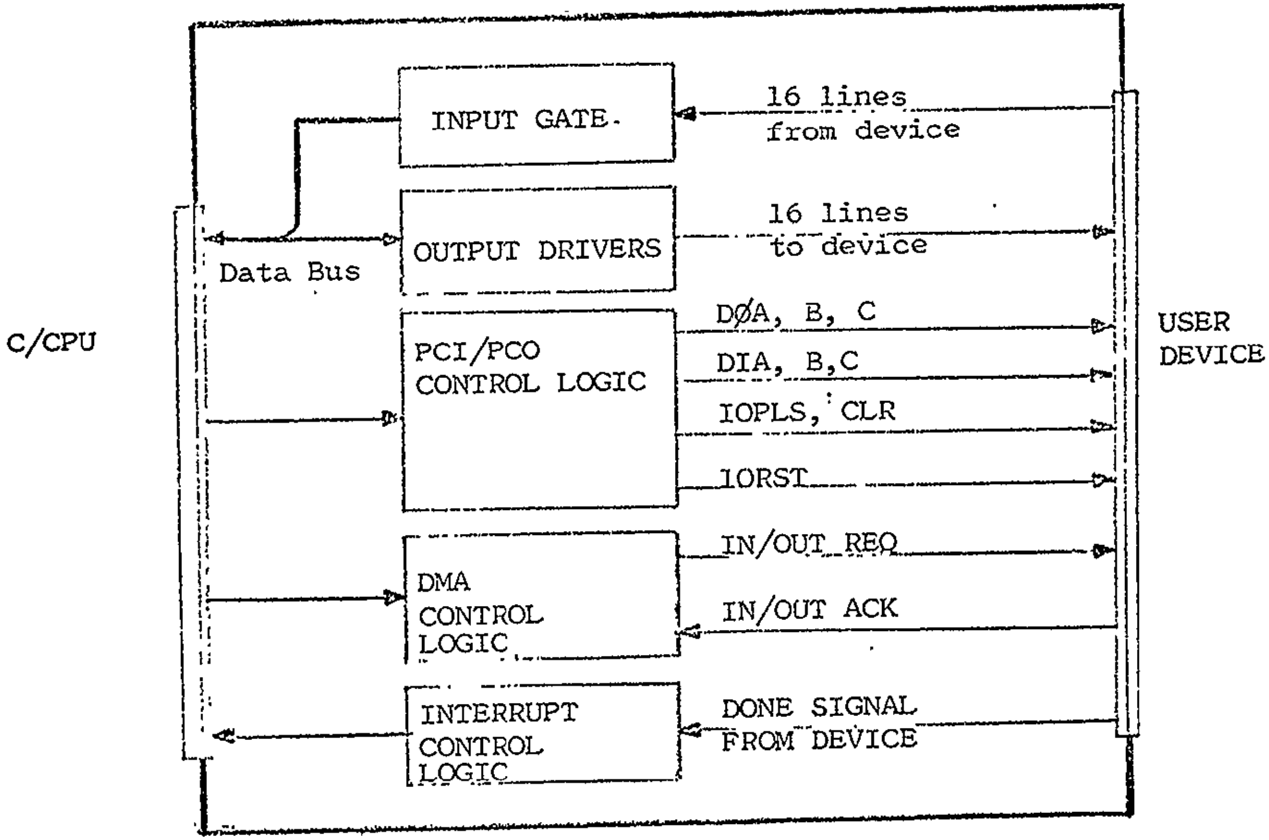

Figure 8-24. DATA BUS INTERFACE UNIT

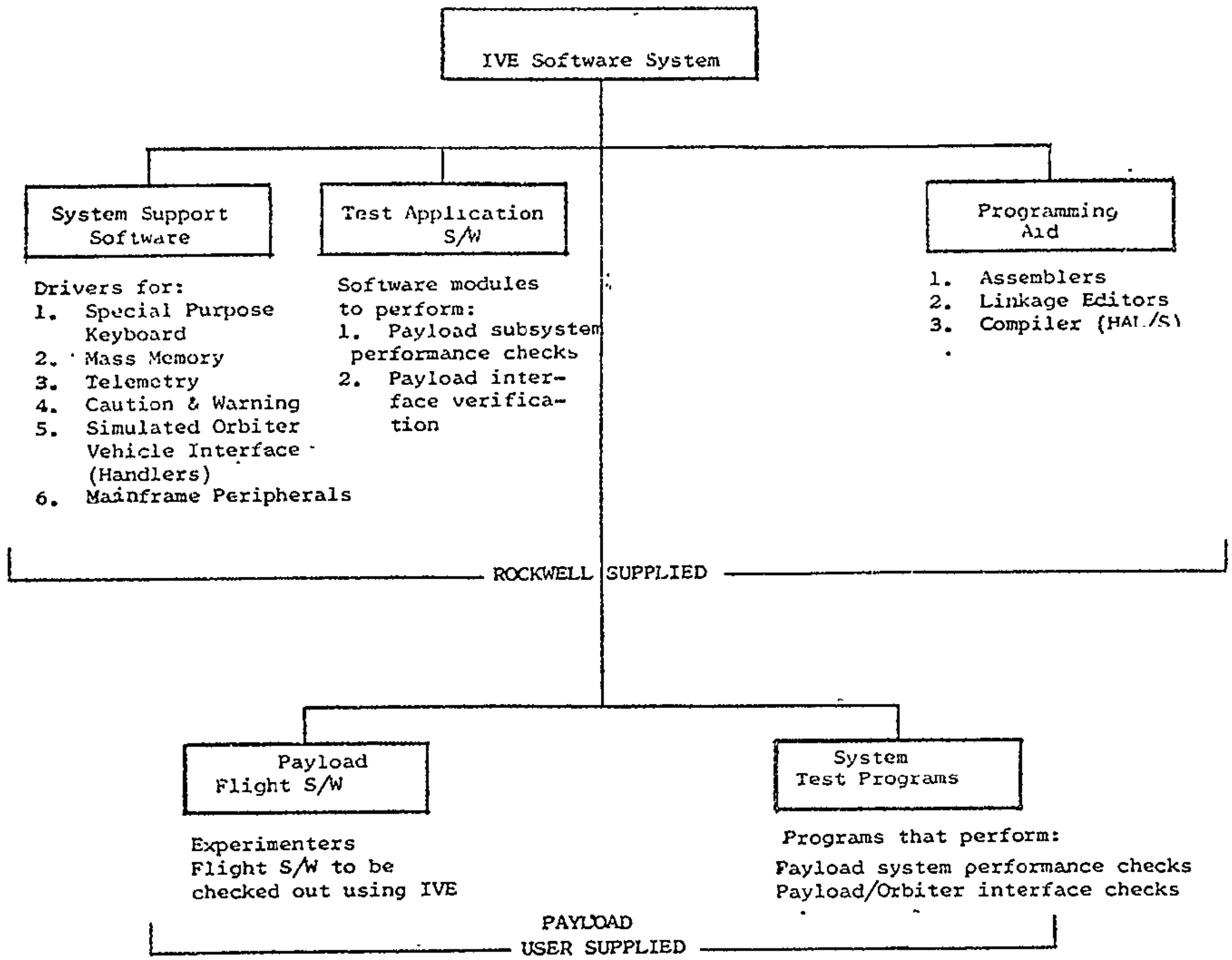

Figure 8-25. SOFTWARE SYSTEM

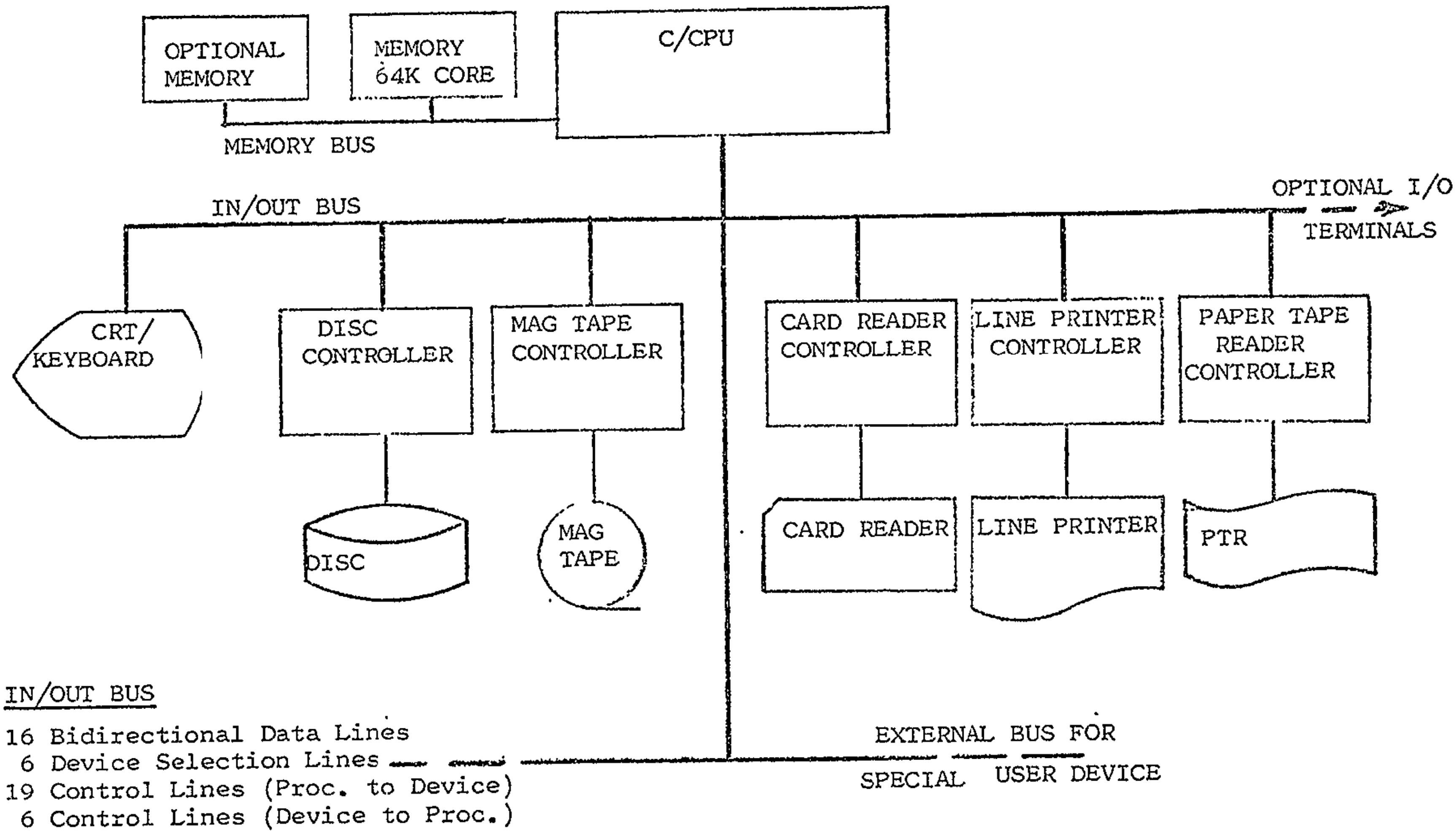

Figure 8-26. DATA MANAGEMENT SYSTEM - C/CPU & PERIPHERALS

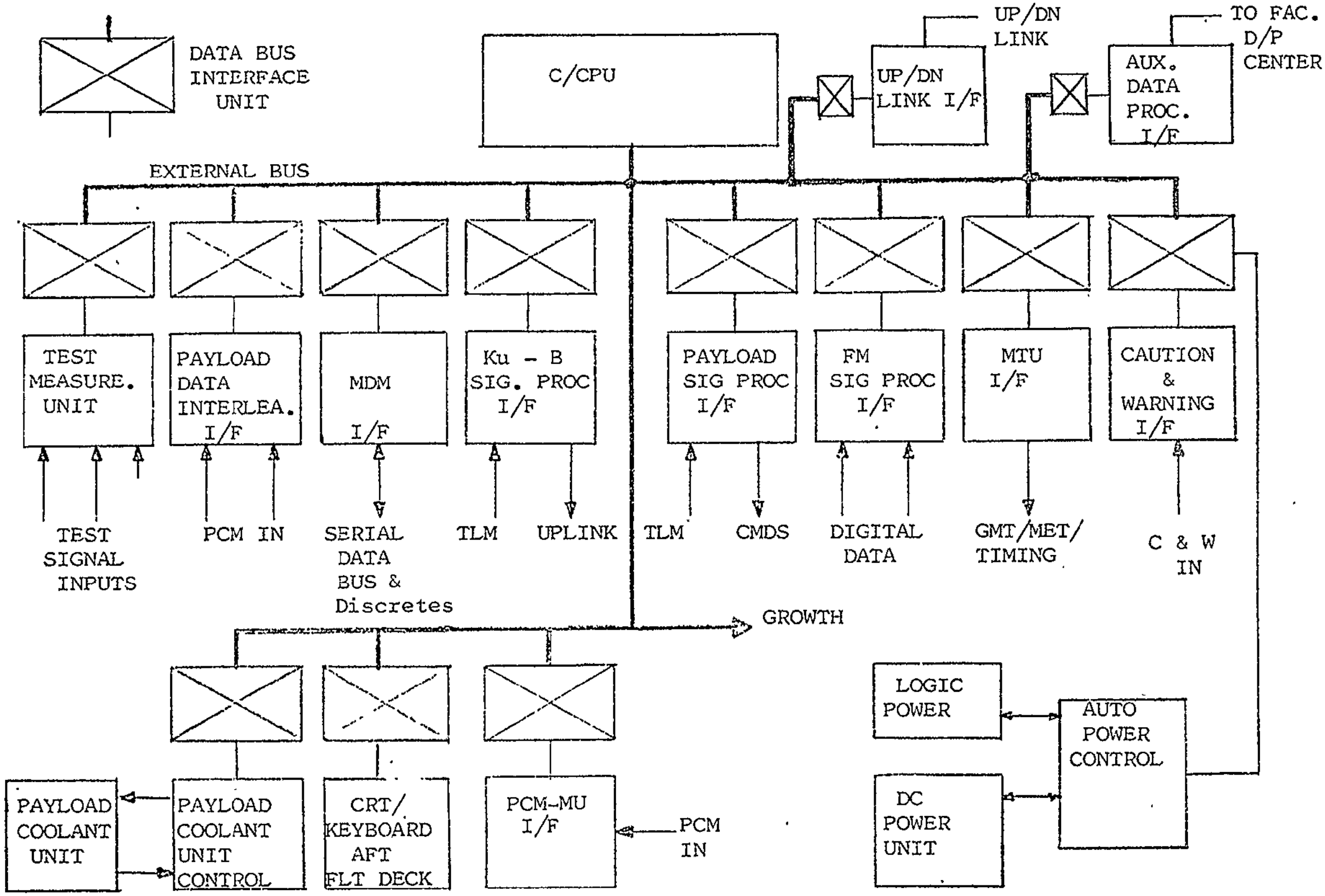

Figure 8-27. DATA MANAGEMENT SYSTEM - C/CPU & I/O INTERFACES

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9.0 STANDARD IVE FLUID SUBSYSTEMS

9.1 SCOPE

The Standard IVE does not contain any fluid subsystem capability. All fluid I/F capability is available as optional equipment as defined in Section 10.6.

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10.0 OPTIONAL EQUIPMENT

10.1 SCOPE

This section establishes the performance design and verification requirements for optional equipment used to augment the standard IVE. The IVE shall be augmented by optional equipment to provide flexibility in performance and cost savings associated with IVE configurations tailored to specific users needs.

The data presented in Section 10 reflects the latest Orbiter payload accommodations configuration at the time this study was conducted. Data presented is adequate for identification of optional equipment, hardware sizing and to support schedule planning and development of cost estimates. Detail design at the I/F requires data update to reflect the current Orbiter design configuration.

10.2 APPLICABLE DOCUMENTS

See Paragraph 2.0

10.3 REQUIREMENTS

The requirements of paragraph 3.0 are applicable to this section.

10.4 STRUCTURE AND MECHANISM SUBSYSTEM

10.4.1 Primary Longeron Fitting - Nondeployable P/L

10.4.1.1 Purpose

Simulate the payload to Orbiter primary longeron fitting which reacts payload induced loads in the X-X and Z-Z axes.

10.4.1.2 Requirements

Provide a retention system capable of reacting induced loads from a 65,000 pound payload in the X-X and Z-Z axes. The payload trunnion shall be free to float in the Y-Y axis. The payload retention system shall be capable of indexing to the longeron at all X_o station attach locations. The design shall accommodate orbiter angular movement/misalignment requirements for ground and flight conditions.

10.4.1.3 Description

The nonaeployable payload primary longeron fitting includes a pivoting upper journal cap, a locking lower journal and a spherical race and bearing that interfaces with the P/L trunnion. The race and bearing provides three degrees freedom of rotation between the payload and IVE. A bridge fitting is also part of the equipment and provides the connecting structural member between the journal assembly and the longeron structure. Figure 10-1 presents an illustration of a typical primary longeron fitting installation. Indexing the journal assembly at the required X_o station locations is accomplished with two shear pins passing thru the base of the lower journal into predrilled holes in the top rail portion of the bridge fitting.

Left and Right Hand configurations of the journal assembly and bridge fitting are required for this equipment.

10.4.1.4 Major Components

Items	HUL I.D. Number (See Volume II)
Journal Assembly (L&R)	4003-01-000
Bearing (2)	4003-01-003
Shear Pin (4)	4003-01-004
Race (2)	4003-01-005

10.4.2 Stabilizing Longeron Fitting - Nondeployable P/L

10.4.2.1 Purpose

Simulate the payload to Orbiter attach interface that will react payload induced loads in the Z-Z axis.

10.4.2.2 Requirements

Provide a retention system capable of reacting induced loads fro a 65,000-pound paylaod in the Z-Z axis. The payload trunnion shall b free to float in the X-X and Y-Y axes. The design shall accommodate Orbiter angular movement/misalignment requirements during ground and

flight conditions.

10.4.2.3 Description

The non-deployable payload stabilizing longeron fitting consists of a pivoting upper journal cap, a locking lower journal and a spherical race and bearing that interfaces with the P/L trunnion. The race and bearing provides three degrees freedom of rotation between the payload and Orbiter. A bridge fitting is also a part of the equipment and provides the connecting structural member between the journal assembly and the payload. The journal assembly is free to slide on the bridge fitting in the X-X direction. An illustration of the fitting installation is presented in Figure 10-1. Left-and right-hand configurations of the journal assembly and the bridge fitting are required for this equipment.

10.4.2.4 Major Components

Item	HUL I.D. NO. (See Volume II)
Journal Assembly (L&R)	4003-01-000
Bearing (2)	4003-01-003
Race (2)	4003-01-005

Note:

The parts in this equipment are identical to those in the non-deployable payload primary longeron fitting equipment except that the shear pin (PN 4003-01-004) is not required.

10.4.3 Primary Longeron Fitting - Deployable Payload

10.4.3.1 Purpose

Simulate a primary payload to Orbiter structural interface which reacts payload induced loads in the X-X and Z-Z axes. Provide a latching/unlatching device for on-orbit payload separation and recovery.

10.4.3.2 Requirements

Provide a remote latching/unlatching retention system simulating the Orbiter interface capable of reacting induced loads from a 65,000

pounds payload in the X-X and Z-Z axis. A means of aligning the payload trunnion with the latching mechanism is required during on-orbit deployment and retrieval operations. The retention system shall be capable of indexing to the longeron at all X_o station attach locations. The design of the retention system shall accommodate angular movement/misalignment requirements as defined by the Orbiter.

10.4.3.3 Description

Figure 10-3 presents a conceptual illustration of a deployable primary longeron fitting. Included in this approach is a remote controlled electro-mechanical operated latch for retention of the payload trunnion, a two position guide for capture and alignment of the trunnion with the retention mechanism and a spherical race and bearing which provides angular adjustment between the payload and orbiter. The fitting would also incorporate the basic features used on the nondeployable primary longeron fitting for attaching to the bridge fitting, indexing to the desired X_o station locations and reacting the X-X loads with shear pins.

10.4.3.4 Major Components

TBD

10.4.4 Stabilizing Longeron Fitting - Deployable Payload

10.4.4.1 Purpose

Simulate a stabilizing payload to orbiter structure interface which reacts payload induced loads in the Z-Z axis. Provide a latching/unlatching device for orbiter deployment of the payload.

10.4.4.2 Requirements

The requirements are the same as for the deployable primary longeron fitting (Paragraph 10.4.3.2) with the following exception: the fitting shall react loads only in the Z-Z axis and shall be allowed to float in the X-X and Y-Y axes.

10.4.4.3 Description

Figure 10-3 presents a conceptual illustration of a deployable stabilizing longeron fitting. This configuration is identical to that of the deployable primary longeron fitting except that the shear pins used to resist X-X loads are not required in the stabilizing fitting.

10.4.4.4 Major Components

TBD

10.4.5 Auxiliary Keel Fitting

10.4.5.1 Purpose

Simulate Orbiter to payload keel attach interface for payload induced loads.

10.4.5.2 Requirements

Provide simulated keel attach fittings for payload induced loads at Orbiter defined attach locations. Design concept shall provide flexibility for tailoring to specific user requirements and shall facilitate installation and removal from the IVE.

10.4.5.3 Description

The auxiliary keel fitting shall be an exact replica of the Orbiter flight design with respect to the payload interface. The keel fitting is attached to a bridge support which in turn is supported by the IVE primary structure as shown in Figure 10-5. The keel fitting is machined from steel and is bolted to the bridge support at the desired attach location. The bridge support consists of two steel Z-shaped sections which are bolted to the primary structure diagonal and cross members. Each bridge support is predrilled enabling the keel fitting to be located at any specific available attach location.

10.4.5.4 Major Components

Item	HUL I.D. NUMBER (See Vol. II)
Keel Fitting	4104-00-000

10.4.6 X_O576 Airlock Interface

10.4.6.1 Purpose

Provide a mechanical simulation of the interface between the Orbiter and the Spacelab tunnel at Station X_o576.

10.4.6.2 Requirements

An exact replica of the mating interface between the Orbiter and the tunnel shall be provided. The structural stiffness shall be adequate to support the tunnel loads and maintain interface location integrity. The tunnel interface assembly shall be designed to facilitate installation and removal.

10.4.6.3 Description

The X_o576 airlock interface structure consists of a machined aluminum ring and steel C-channel supporting structure for bolt-on attachment to the aft flight deck support stand assembly as shown in Figure 10-6.

10.4.6.4 Major Components

Item	HUL I.D. NUMBER (See Vol. II)
Ring-Airlock/Tunnel Interface	4101-00-001
Attach Brackets (2)	4101-00-002
Attach Bracket (2)	4101-00-003

10.4.7 X_o660 Tunnel Interface

10.4.7.1 Purpose

Provide a mechanical simulation of the tunnel adapter interface at X_o660 and Z_o355.

10.4.7.2 Requirements

The structural opening shall be an exact replica of the Orbiter at the interface with the tunnel. The tunnel adapter structures shall be of adequate stiffness to maintain interface location integrity and to support the tunnel weight when attached. The tunnel adapter will be mounted to the mid-body structure in such a way as to facilitate in-

stallation and removal.

10.4.7.3 Description

The X_O660 tunnel adapter consists of a machined aluminum ring and support structure to fasten to the midbody primary structure. The support structure consists of steel C-channels. The primary tunnel loads are transmitted through the support structure to the keel mounting pads (Figure 10-7). Ring stability is provided by upper supports.

10.4.7.4 Major Components

Item	HUL I.D. NUMBER (See Vol. II)
Ring-Tunnel Interface	4102-01-001
Upper Support Assembly-Left	4102-01-002
Upper Support Assembly-Right	4102-01-003
Lower Support Forward	4102-01-004
Lower Support Aft	4102-01-005

10.4.8 Upper Payload Clearance Gage

10.4.8.1 Purpose

Verify that the payload does not violate the payload envelope established by Orbiter configuration control.

10.4.8.2 Requirements

The payload dynamic envelope is defined as a 90 inch radius with the center located at a Y_O=0 and a Z_O=400. A positive means shall be provided to locate the upper portion of this cylinderical envelope along the length of the payload bay. A method shall be provided to measure the radial distance between the payload and the allowable payload envelope and to detect any payload protrusions exceeding the 90 inch radius.

10.4.8.3 Description

The clearance gage incorporates a semi-circular wiper template contoured to represent the upper half of the payload envelope above the

longerons. The template is attached to a translating support structure that rolls the length of the payload bay on guide rails attached to each longeron. An illustration of the clearance gage and the structural configuration is presented in Figure 10-8. The wiper template consists of three removable segments and can be configured for specific payload clearance radii requirements. Two hook eyes are incorporated in the support structure to facilitate installation/removal of the gage.

Installation locating tool design TBD.

10.4.8.4 Major Components

Item	HUL I.D. NUMBER (See Vol. II)
Leg Support Assy (2)	4105-01-000
Horizontal Support Assy	4105-02-000
Center Template Assy	4105-03-000
Side Template Assy (2)	4105-04-000
Guide Rail (6)	4105-00-003
Installation Tool	4105-00-004

10.4.9 Lower Payload Clearance Gage

10.4.9.1 Purpose

Verify that the payload does not violate the payload envelope established by Orbiter configuration control.

10.4.9.2 Requirements

The payload envelope is defined as a 90 inch radius with the center located at a $Y_O=0$ and $Z_O=400$. A positive means shall be provided to locate the lower portion of this cylinderical envelope along the length of the payload bay. A method shall be provided to measure the radial distance between the payload and allowable payload envelope and to detect any payload protrusions exceeding the 90 inch radius. The design concept shall facilitate its installation and removal.

10.4.9.3 Description

The clearance gage incorporates a wiper template contoured to represent the lower portion of the dynamic envelope below the longerons. The template is attached to a translating support structure that rolls the length of the payload bay on guide rails attached to the mid-body structure. Two template segments and translating support structures are provided as shown in Figure 10-9. One segment covers the sector from the longeron to the wire tray. The second segment covers the sector from the wire tray to the centerline at $Y_O=0$. The templates consist of two segments for ease of handling in the area of the trunnions, utility provisions and keel fittings which protrude locally into the 3" payload/orbiter clearance volume. The gage assemblies are removable for use on right and left sides of the IVE. The wiper templates are removable and a slotted attachment design facilitates proper installation.

Installation locating tool design (TBD).

10.4.9.4 Major Components

Item	HUL I.D. NUMBER (See Vol. II)
Center Gage Assy	4106-01-000
Center Template	4106-01-001
Template Support	4106-01-002
Base Support (2)	4106-01-005
Roller (4)	4106-01-006
Center Roller Guide (6)	4106-00-001
Outer Roller Guide (6)	4106-00-002
Side Gage Assy	4106-02-000
Side Template	4106-02-001
Template Support	4106-02-004
Base Support (2)	4106-02-005
Roller (4)	4106-02-006
Roller Guide (12)	4106-00-003
Support Bracket (36)	4106-00-004
Installation Tool	4106-00-005

10.4.10 OMS Delta V Envelope

10.4.10.1 Purpose

Simulate the envelope of the OMS Delta V kit to support verification that the payload does not violate the clearance envelope.

10.4.10.2 Requirements

Provide a mockup of the OMS delta V critical payload bay clearance. Provide a structural support for the envelope that will interface with the nondeployable payload primary longeron fittings.

10.4.10.4 Major Components

TBD

10.4.11 Payload Bay Liner

10.4.11.1 Purpose

Simulate the inner mold line of the Orbiter structure in the lower payload bay in order to verify payload compliance within allowable payload envelope and support development of payload installation procedures and timelines.

10.4.11.2 Requirements

Provide a "hard" liner in the lower payload bay from X_O Stations 576 to 1307. The liner shall simulate the contour of the Orbiter payload bay structure defined by a 93.5-inch radius located at a Z_O=400 and a Y_O=0 which fairs into a vertical line at a Y_O=93.5 inches. The installation tolerance on the liner contour is TBD. The design should reflect a low-cost approach using readily available materials.

10.4.11.3 Description

The payload bay liner equipment provides a liner installation for a 20-foot section of the mid-body structure. This modularization approach provides for tailoring the configuration to specific user needs with associated cost savings.

The liner consists of a sheet of expanded metal (open grid) preformed to match the contour of the Orbiter structure in the payload bay. The liner is supported by a set of longeron and contoured frame elements that utilize a common hat cross section. Liner panels 3' x 10' and 4' x 10' are attached to the flanges of the hat sections thus simulating the cylindrical shape of the payload bay. One or more panels may be used

in combination with another to create any desired configuration for the liner. Figure 10-10 displays the typical structural elements of the liner equipment and its attachment to the mid-body structure.

With the payload bay liner as a reference, a depth gage may be used to measure payload clearances to verify that the payload does not exceed its allowable envelope. The lower payload clearance gage equipment is not used when the payload bay liner equipment is installed.

10.3.1.15.4 Major Components

Item	HUL I.D. NUMBER (See Vol. II)
Contoured Frame-Hat (36)	4116-00-001
End Frame (24)	4116-00-002
Longeron (6)	4116-00-003
Bracket Support (6)	4116-00-005
Bracket Support (6)	4116-00-006
Liner Panel #1 (4)	4116-00-009
Liner Panel #2 (8)	4116-00-010
Liner Panel #3 (2)	4116-00-011

10.4.12 T-O Umbilical Assembly

10.4.12.1 Purpose

Simulate Orbiter T-O umbilical panel I/F for payload ground operations.

10.4.12.2 Requirement

Provide electrical and fluid interfaces simulation of dedicated payload I/F's. Provide only capability for fit and pressure leak check for fluid lines.

10.4.12.3 Description

The T-O umbilical assembly consists of a right-and-left-hand structural panel with supporting brackets to attach to the X_o1307

bulkhead assembly. Panel interconnectors for all fluid and electrical payload I/F functions are part of this assembly.

10.4.12.4 Major Components

TBD

10.4.13 X_o1307 End Support Assembly

10.4.13.1 Purpose

Stabilize the mid-body for supporting payloads when the X_o1307 bulkhead is not utilized.

10.4.13.2 Requirement

Provide a structural interconnect between the midbody (X_o1307) structural members to provide structural stability during IVE operation with up to a 65,000 pound payload installed.

10.4.13.3 Description

The end support assembly shall consist of low carbon tubular steel members with attach plates such that a stable interconnect is made between the side longerons, the lower chord and keel bean support elements of the primary structure.

10.4.13.4 Major Components

Item	HUL I.D. Number (See Vol. II)
Cross Tie	2106-00-001
Diagonal Support (2)	2106-00-003
Attach Gusset	2106-00-005
Attach Plate (5)	2106-00-002

10.5 ELECTRICAL SUBSYSTEM

10.5.1 Payload Bay Floodlight Assembly

10.5.1.1 Purpose

To provide illumination of the payload bay interior surfaces, the

payloads and their interfaces during installation and operations in the IVE.

10.5.1.2 Requirements

The light box installation shall be flush with the payload bay liner mold line. The lights shall be remotely controlled from the aft crew station. Light intensity levels are TBD.

10.5.1.3 Description

Light assemblies are provided at three X_o stations on the left and right sides as shown in Figure 10-11. A typical assembly includes a light box (approximately 12 x 6 x 4 inches), lamp, support brackets, and electrical cables. Supports are independent of the P/L bay liner kit which is optional. A lighting angle of approximately 135^o will provide the required light distribution. A light control panel will be located on the OOS. A light assembly is also provided at X_o576 station between the observation windows as shown in Figure 10-12. A typical assembly includes a light box (approximately 12 x 6 x 4 inches) lamp, support bracket and electrical cables.

10.5.1.4 Major Components

Item		HUL I.D. NUMBER (See Vol. II)
Payload Bay		
Floodlight (6)		4019-00-001
Upper Bracket (4)	Z_o 331.75 Light	4019-00-002
Lower Bracket (4)		4019-00-003
Upper Bracket (2)	Z_o 380 Light	4019-00-004
Lower Bracket (2)		4019-00-005
Wire Harness (6)		4019-00-006
Switch (3)		4019-00-007
X_o 576 Bulkhead		
Floodlight (1)		4108-00-001
Bracket (2)		4108-00-002

Item	HUL I.D. NUMBER (See Vol. II)
X_o 576 Bulkhead	
Wire Harness	4108-00-003
Switch (1)	4108-00-004

10.5.2 Closed Circuit TV (CCTV) Assembly

10.5.2.1 Purpose

The electrical subsystem CCTV unit shall provide a closed circuit television system for facilitating payload handling operations and monitoring testing activities.

10.5.2.2 Requirements

CCTV system shall accept video data from the following inputs:

a. Payload TV system

b. Payload bay aft (X_o1307 bulkhead) and forward cameras (X_o576 bulkhead)

c. Pattern generator

d. Portable TV camera as required by test personnel

Video data shall be displayed at the following locations:

a. Two monochrome CCTV monitors on the aft flight deck

b. A monochrome CCTV monitor in the operator's console

c. Remote locations as specified by test personnel

In addition to the above the following requirements are specified:

a. A video switching unit shall be provided for video data selection and distribution

b. All CCTV camera lenses shall be remote controlled

c. All pan/tilt assemblies shall be remote controlled

d. A master synchronization signal shall be provided for all CCTV cameras, monitors, and the payload TV system that is not part of the Orbiter TV system.

The CCTV system shall operate from ac/dc bus system of the operato console. The CCTV system shall be capable of operation with the variou hardline interfaces shown in Figure 10-13 and as referenced in paragraph 8.3.1.2.4, Item II. Detailed specifications and requirements for the electrical subsystem CCTV interface channels shall be as specified in the CCTV system specification, ICD 3-0050-01. The CCTV system functional interface shall be simulated by the signal conversion module within the AIE. Signal Conversion Module A4 shall consist of the following devices:

a. Video amplifier

b. Synchronization generator

c. Pattern generator

d. Video distribution and switching network

The camera mounts consist of light weight aluminum supports which are attached to the X_o1307 bulkhead (Figure 10-14) in such a way as to locate the TV camera's neutral axis at approximately Z_o463, Y_o73 and with aft face of camera at X_o1307, and the X_o576 bulkhead as shown in Figure 10-15. The remote control panel is located in the OOS as shown in Figure 8-5. The TV monitor is located above and aft of the PS console. Camera performance characteristics under consideration are:

Type	Black and White
Pan	90° Left and Right
Tilt	85° Up, 45° Down
Zoom Ratio	Approximately 10:1
Field of View	Approximately 5° to 50°

10.5.2.4 Major Components

Item	HUL I.D. NUMBER (See Vol. II)
X_o 1307	
TV Camera Assembly	4115-01-000

10.5.2.4 Major Components (Cont)

Item	HUL I.D. NUMBER (See Vol. II)
X_o1307	
Remote Control Unit	4115-02-000
Zoom Control	4115-02-001
Tilt & Pan Control	4115-02-002
Control Panel	4115-02-003
Camera Support Assembly	4115-03-000
T.V. Montior Assembly	4115-04-000
X_o 576	
T.V. Camera Assembly (1)	4014-01-000
Zoom Lens	4014-01-001
Tilt and Pan Control	4014-01-002
Vidicon Tube	4014-01-003
Remote Control Unit	4014-02-000
Zoom Control	4014-02-001
Tilt and Pan Control	4014-02-002
Control Panel	4014-02-003
Camera Installation	4014-03-000
Base	4014-03-001
Bracket (2)	4014-03-002
Cable Set	4014-03-003
TV Monitor Assy	4014-04-000
Monitor Unit	4014-04-001
Base	4014-04-002
Bracket (2)	4014-04-003

10.5.3 Preflight Umbilical Electrical Panel Assembly

10.5.3.1 Purpose

Simulate the payload to Orbiter electrical interface at the

10.5.3.1 Purp· ·: (Cont)

prelaunch umbilical (T-4) panel.

10.5.3.2 Requirements

Provide a mounting plate and electrical connnectors required to support the payload at the preflight umbilical up to T-4 hours. Provide data on installation of the plate on the mid-body structure at X_o835.

10.5.3.3 Description

A prefabricated stiffened panel is attached to the existing secondary structure located at Station X_o835 on the left side of the IVE structure as shown in Figure 10-16. An area of approximately 11 x 15 inches was allocated for the electrical interface panel. Penetrations and connectors (TBD) are located on the plate to simulate specific payload to Orbiter interfaces. Different plate configurations may be required to accommodate variations in payload requirements.

10.5.3.4 Major Components

Item	HUL I.D. NUMBER (See Volume II)
Umbilical Electrical Panel	4017-00-001
Electrical Connectors (Size and quantity of connectors are TBD)	4017-00-002

10.5.4 X_o1307 Electrical Service Panel Assembly

10.5.4.1 Purpose

Simulate the payload to orbiter electrical service interface at the X_o1307 bulkhead.

10.5.4.2 Requirements

Provide a mounting plate on the X_o1307 bulkhead for the electrical connectors required to support payload operations to simulate the Orbiter interface. Provide data for installation of panel on the X_o1307 bulkhead. Provide electrical cables from connectors to power source.

10.5.4.3 Description

Two electrical service panels are attached to the X_o1307 bulkhead which provide secondary power, communications and data ground monitoring capability for the payload. The size of each panel is approximately 10 inches square with one 36 size shell connector for power and two 22 size shell connectors for data mounted on each panel as shown in Figure 10-17.

10.5.4.4 Major Components

Item	HUL I.D. NUMBER (See Vol. II)
Panel Assembly (LH)	4124-01-000
Panel Assembly (RH)	4124-02-000
36 Size Shell Connector (2)	4124-00-001
22 Size Shell Connector (4)	4124-00-002

10.5.5 X_o576 P/L Service Panel Assembly

10.5.5.1 Purpose

Simulate the payload to Orbiter electrical interface at X_o576 P/L Service panel assembly on right side of Orbiter.

10.5.5.2 Requirements

Provide a mounting plate and electrical connectors required to support the payload at the X_o576 connector panel.

10.5.5.3 Description

Two electrical service panels as shown in Figure 10-18 are attached to the X_o576 bulkhead which provide communications and ground monitoring capability for the payload. Penetrations and connectors (TBD) are located on the plate to simulate specific payload to Orbiter interfaces.

10.5.5.4 Major Components

Item	HUL I.D. NUMBER (See Vol. II)
Panel Assembly	TBD

10.5.5.4 Major Components (Cont)

Item	HUL.I.D. NUMBER (See Vol. II)
Electrical Connectors (Size and Quantity of Connectors are TBD)	TBD

10.5.6 Cable Sets

10.5.6.1 Purpose

Provide interconnect between (1) the DC power set and the X_o1307 payload I/F electrical service panels and (2) the X_o1307 payload I/F electrical service panels and the T-O launch Umbilical panel.

10.5.6.2 Requirements

Provide power transfer from the DC Power Set to the X_o1307 electrical panels as shown in Figure 8-7 with the following performance requirements: 27 to 32 vdc, 1.5 kw average and 2 kw peak power and TBD voltage drop at a TBD impedance. Support payload integration test operations by providing access to the payload X_o1307 bulkhead interface for data and ground monitoring equipment.

10.5.6.3 Description

One electrical cable assembly shall be provided for transfer of power from the DC Power Set to the X_o1307 payload interface. Cable assembly shall be approximately TBD feet in length and consist of 4 number 4 AWG wires. One electrical cable assembly will be provided for transfer of data and ground monitoring signals between the X_o1307 payload interface and the T-O launch umbilical panel assemblies, right and left hand side.

10.5.6.4 Major Components

Item	HUL I.D. NUMBER (See Vol. II)
X_o1307 power cable set	4127-01-000
X_o1307/T-O cable set	4127-02-000
(Size and number of wires, connectors TBD)	

10.5.7 Software

10.5.7.1 HAL/S Compiler (IBM 360)

Provides off-line compiling of programs in HAL/S using an IBM 360.

10.5.7.2 HAL/S Compiler (IVE)

Provides on-line compiling of programs in HAL/S using the IVE data management subsystem.

10.5.7.3 GOAL Compiler

Provides on-line compiling of GOAL programs using the IVE data management subsystem.

10.6 FLUID SUBSYSTEM

10.6.1 Environmental Control Unit Set (ECUS)

10.6.1.1 Purpose

The ECUS shall provide thermal control capability for cooling the payload during test operations.

10.6.1.2 Requirements

The ECUS subsystem shall provide cooling fluids to the payload at the $X_0$636 station using either water or freon 21. The ECUS shall provide a heat rejection capacity of up to 29,500 Btu/hr (30.60×10^6 joules/hr). Refer to paragraph 3.1.2.5 for interface performance.

10.6.1.3 Description

The ECUS subsystem shall consist of a commercial chiller unit, purge and test unit, fluid lines and fittings and control and display panel. Refer to Figure 10-19 for a functional block diagram of the ECUS and Figure 10-20 for the fluid interfaces.

10.6.1.2.1 Fluid System Interfaces

The ECUS shall be designed to be compatible with the following input/output specifications:

Fluid Input

a.	Fluid Media:	Water	Freon 21
b.	Fluid Pressure:	200 psia max.	200 psia max.
c.	Fluid Temperature:	45° (7.2°c)	45°F (7.2°c)
d.	Fluid Flow	600 #/hr max.	2100 #/hr max.

Fluid Output

a.	Fluid Media:	Water	Freon 21
b.	Fluid Pressure:	200 psia max.	200 psia max.
c.	Fluid Temperature:	136°F (58°c)	136°F (58°c)
d.	Fluid Flow:	600 #/hr max.	2100 #/hr max.

10.6.1.2.2 Chilled Water

The ECUS shall be designed to accept facility chilled water for cooling. Water temperature shall not exceed TBD $^{\circ}$F.

10.6.1.2.3 Electrical Power

The ECUS shall be designed to operate from facility 480 vac, 3∅, 50/60 Hz.

10.6.1.4 Major Components

Item	HUL I.D. NUMBER (See Vol. II)
Heat Exchanger Unit	4110-01-000
Control and Display Panel	4110-02-000
Purge and Test Unit	4110-04-000
Interface Panel Assembly	4110-05-000

10.6.2 X_o1307 Fuel and Oxidizer Panel Assemblies

10.6.2.1 Purpose

Simulate the payload to Orbiter cryogenic propellant interface at the X_o1307 bulkhead.

10.6.2.2 Requirements

Provide mounting panel(s) and fluid connectors required to accommodate payload cryogenic propellants. Provide data for installation of the panel(s) on the X_o1307 bulkhead.

10.6.2.3 Description

The X_o1307 oxidizer and fuel panels and their locations on the X_o1307 bulkhead are illustrated in Figure 10-21. Four panels approximately 10 inches square are allocated for the fluid interface at Z_o=362. Fuel panel No. 1 includes provisions for LH_2 fill and drain, LH_2 fuel cell fill and cold helium fill. Fuel panel No. 2 includes provisions for the vent and relief of gaseous hydrogen. Oxidizer panel No. 1 includes provisions for LO_2 fill and drain. Oxidizer panel No. 2 includes provisions for LO_2 fuel cell fill, helium fill and RTG H_2O outlet and inlet. Each panel is predrilled and attaches to the bulkhead with screws and nutplates.

10.6.2.4 Major Components

	HUL I.D. NUMBER
Oxidizer Panel Assembly No. 1	4121-01-000
LO_2 Coupling (5-6" dia)	4121-01-002
Oxidizer Panel Assembly No. 2	4121-02-002
LO_2 Coupling (1" dia)	4121-02-002
Helium Coupling (1/2" dia)	4121-02-003
Fuel Panel Assembly No. 2	4121-03-000
H_2 Coupling (3.5" dia)	4121-03-002
H_2 Coupling (2.5" dia)	4121-03-003
Fuel Panel Assembly No. 1	4121-04-000
LH_2 Coupling (4" dia)	4121-04-002
LH_2 Coupling (1-1/2" dia)	4121-04-003
Helium Coupling (1" dia)	4121-04-004

10.6.3 T-O Umbilical Fluid Interface Assembly

10.6.3.1 Purpose

Simulate the ground-to-Orbiter payload fluid support interface from the T-O umbilical panel to the Xo1307 payload service panels.

10.6.3.2 Requirement

Provide fluid line interconnect between the T-O launch umbilical panel and the X_o1307 payload service panels

10.6.3.3 Description

The T-0 umbilical fluid interface assembly shall consist of fluid lines and terminal connectors. Size of lines, size and number of connectors are TBD.

10.6.3.4 Major Components

Item	HUL I.D. NUMBER (See Vol. II)
Fluid Line Assembly (Number of fluid lines and connectors are TBD)	4129-00-000

10.6.4 Preflight Umbilical Fluid Panel Assembly

10.6.4.1 Purpose

Simulate the Payload-to-Orbiter fluid interface at the prelaunch umbilical (T-4) panel.

10.6.4.2 Requirements

Provide a mounting plate for the fluid connectors required to support the payload up to T-4 hours. Provide data for installation of the mounting plate on the mid-body structure at X_o835.

10.6.4.3 Description

A prefabricated stiffener plate is attached to the existing secondary structure located at Station X_o835 on the left side of the structure. An area of approximately 11 x 15 inches has been allocated for the fluid interface. Penetrations and connectors (TBD) will be located on the plate to simulate specific Payload-to-Orbiter interfaces. Different plate configurations may be required to accommodate variations in payload requirements. A typical panel installation is shown in Figure 10-2:

10.6.4.4 Major Components

Item	HUL I.D. NUMBER (See Vol. II)
Umbilical Fluid Panel (Size and quantity of couplings are TBD)	4018-00-001

10.6.5 Leak Detection Assembly

10.6.5.1 Purpose

Provide a leak detection unit to be used to perform leak checks on the fluid couplings mounted on the $X_0$1307 bulkhead, preflight (T-4) and launch (T-0) umbilical panels.

10.6.5.2 Requirements

Requirements and design are TBD.

10.6.5.3 Description

TBD

10.6.5.4 Major Components

Item	HUL I.D. NUMBER (See Vol. II)

Components TBD

10.6.6 Ground and RTG Cooling Assembly

10.6.6.1 Purpose

Simulate orbiter payload ground cooling and RTG cooling interfaces to the payload.

10.6.6.2 Requirements

Provide payload coolant line interface for payload RTG's and other payload elements requiring cooling during Orbiter ground and flight operations.

10.6.6.3 Description

TBD

10.6.6.4 Major Components

Item	HUL I.D. NUMBER (See Vol. II)

Components TBD

10.7 QUALITY ASSURANCE PROVISIONS

The quality assurance provisions of Paragraph 4.0 are applicable to this section.

10.8 PREPARATION FOR DELIVERY

The delivery requirements of Paragraph 5.0 are applicable to this section.

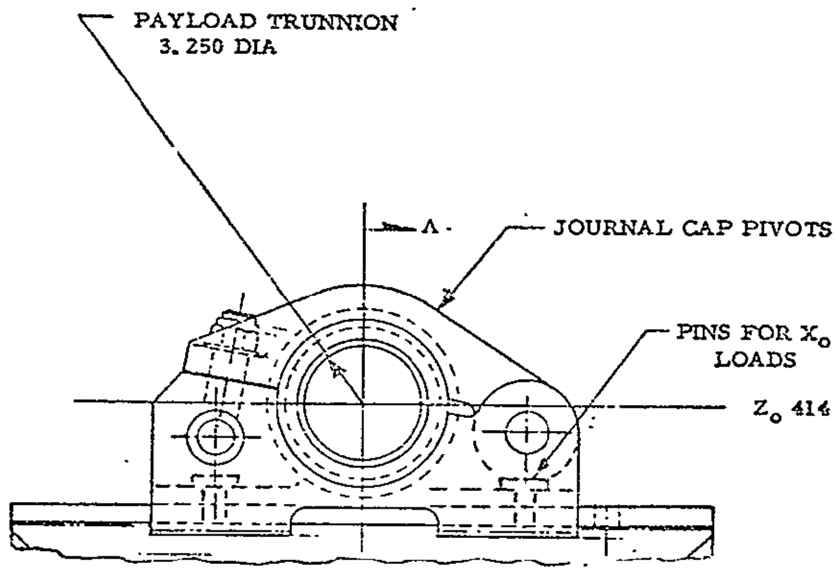

Figure 10-1. LONGERON FITTING-NON DEPLOYABLE

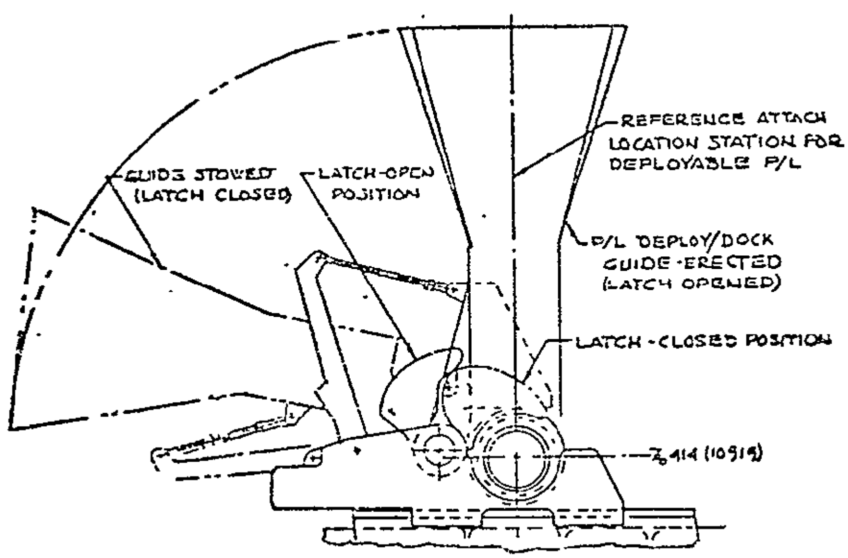

Figure 10-3. LONGERON FITTING - DEPLOYABLE

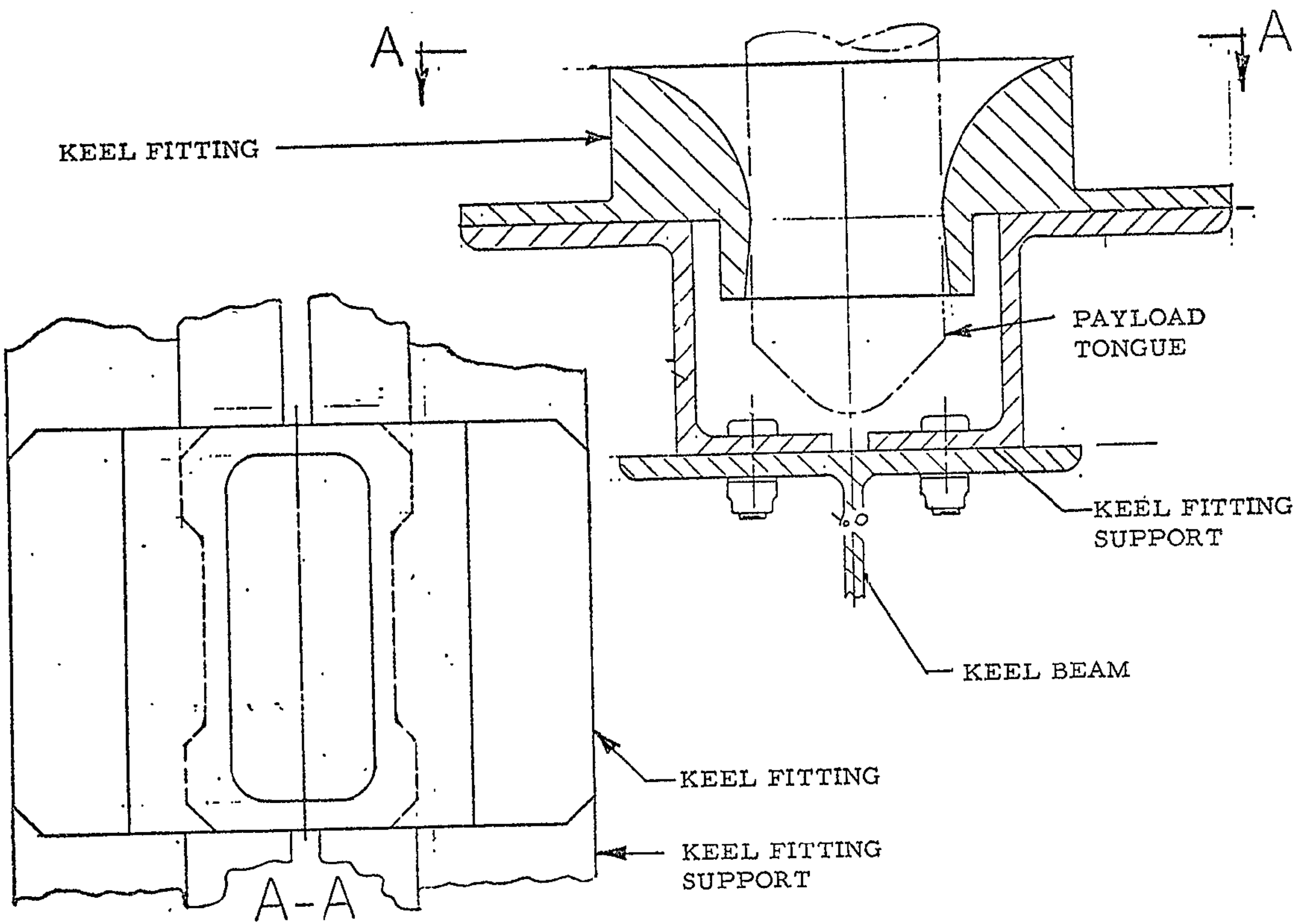

Figure 10-5. AUXILIARY KEEL FITTING

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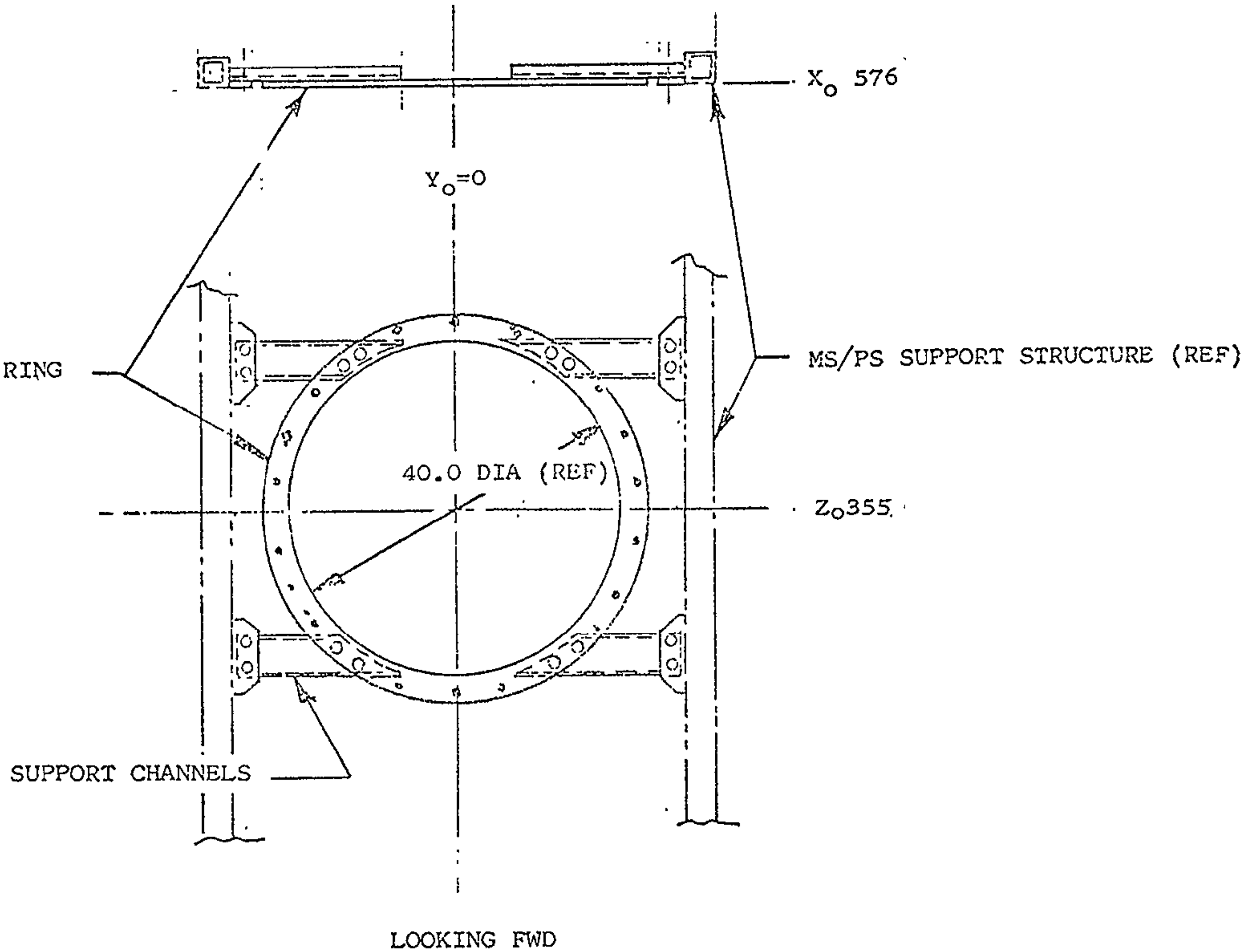

Figure 10-6. X_o576 AIRLOCK INTERFACE

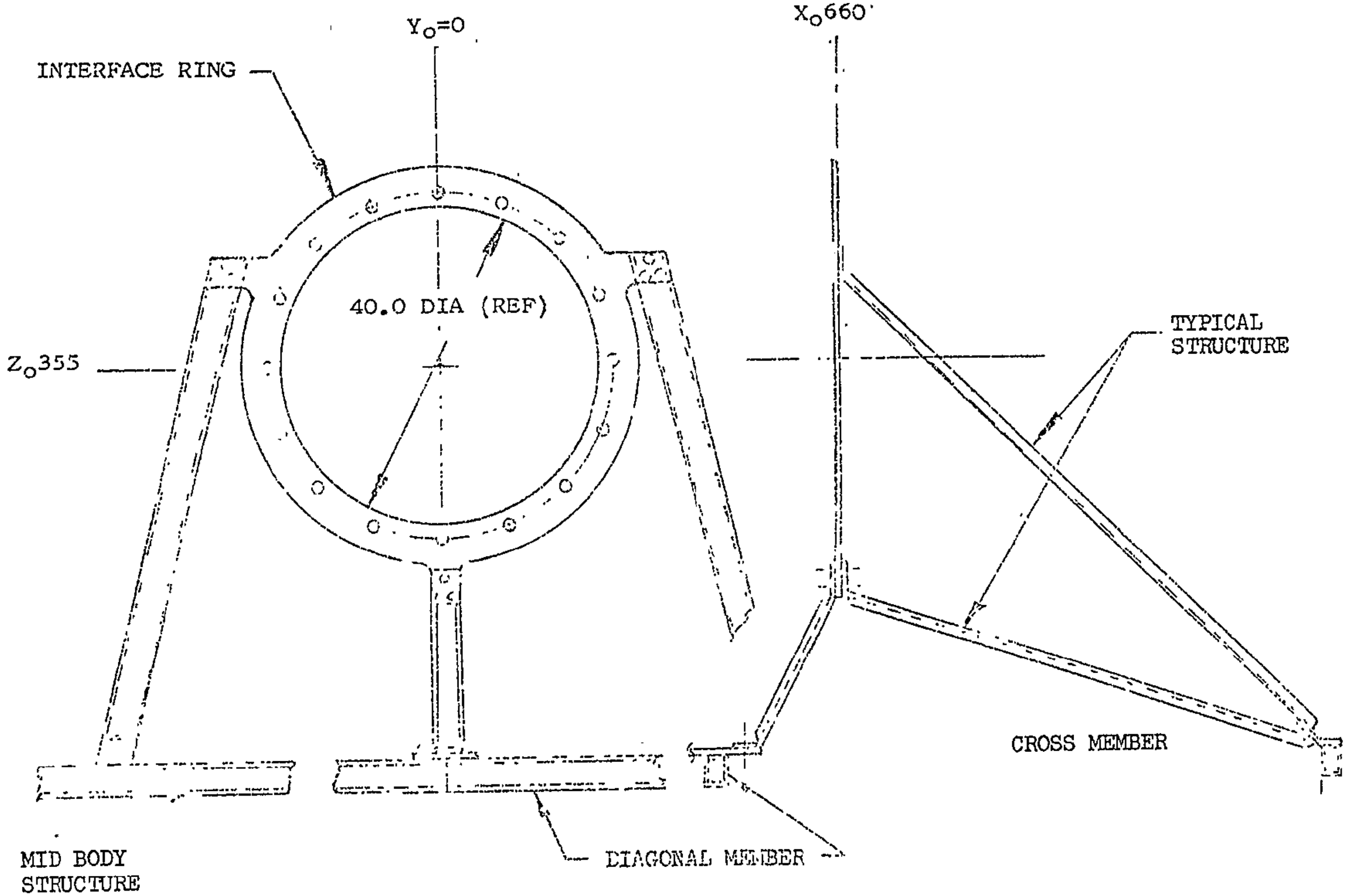

Figure 10-7. X_o 660 TUNNEL INTERFACE

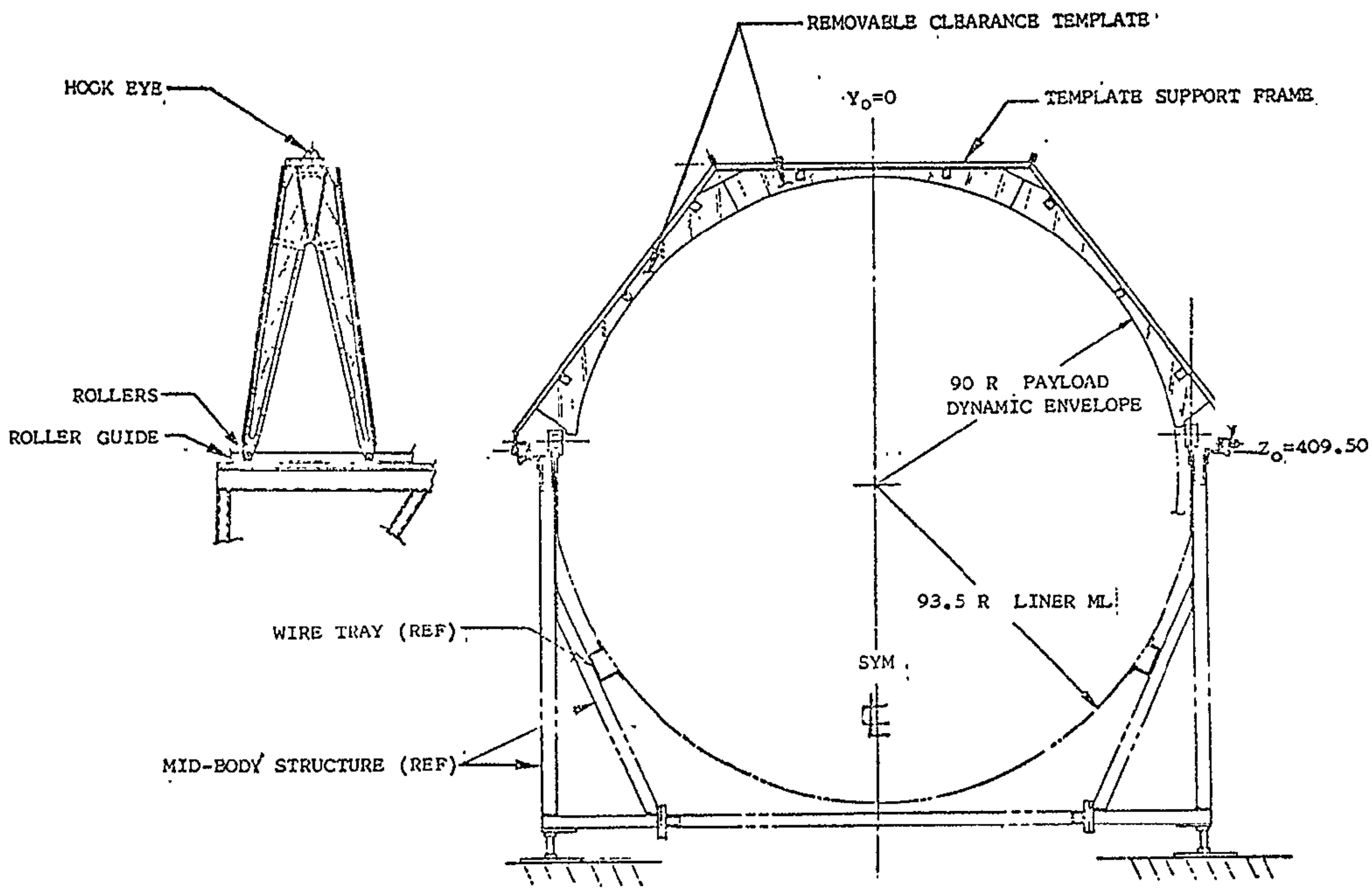

Figure 10-8. PAYLOAD UPPER CLEARANCE GAGE

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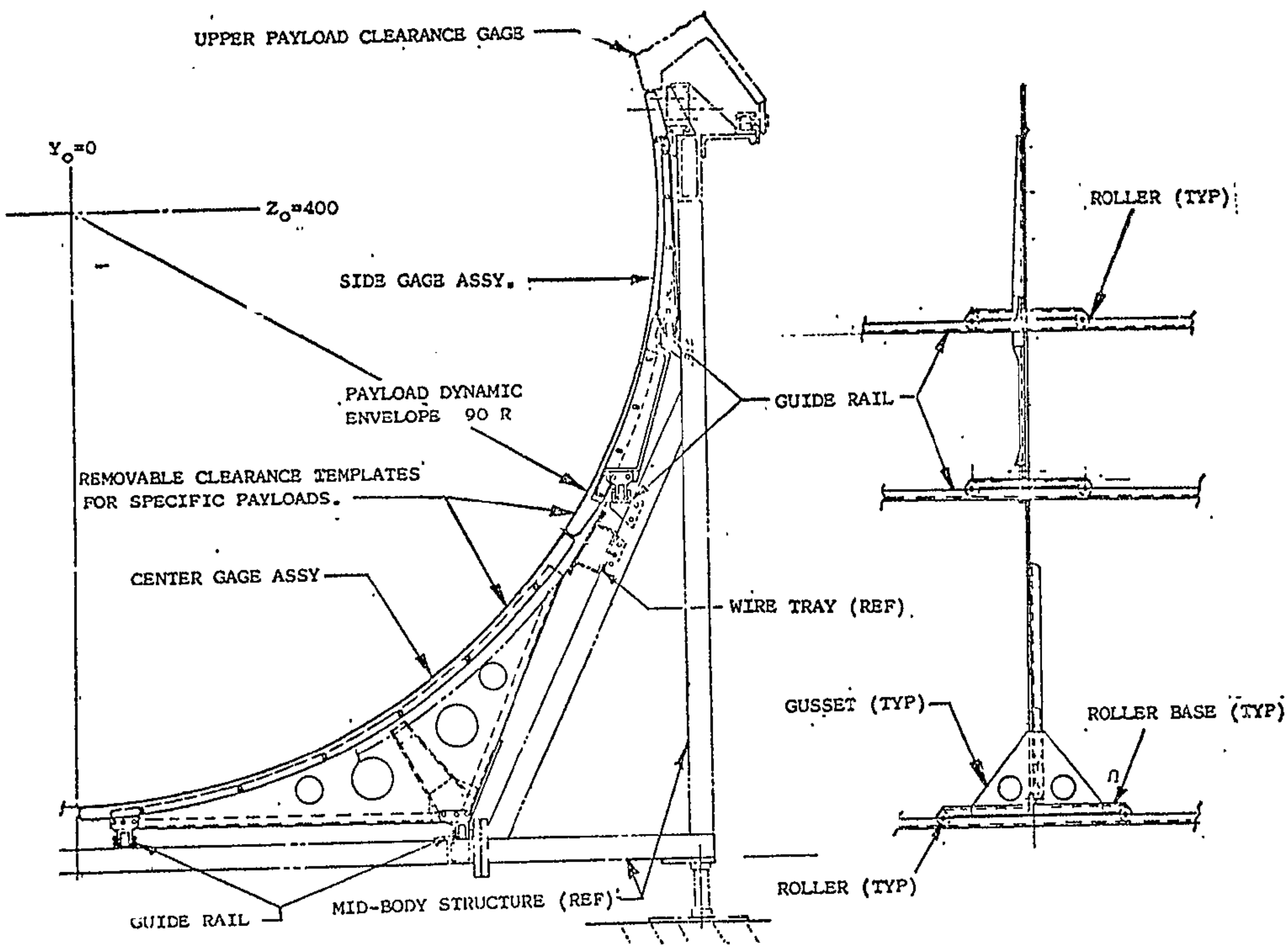

Figure 10-9. LOWER PAYLOAD CLEARANCE GAGE

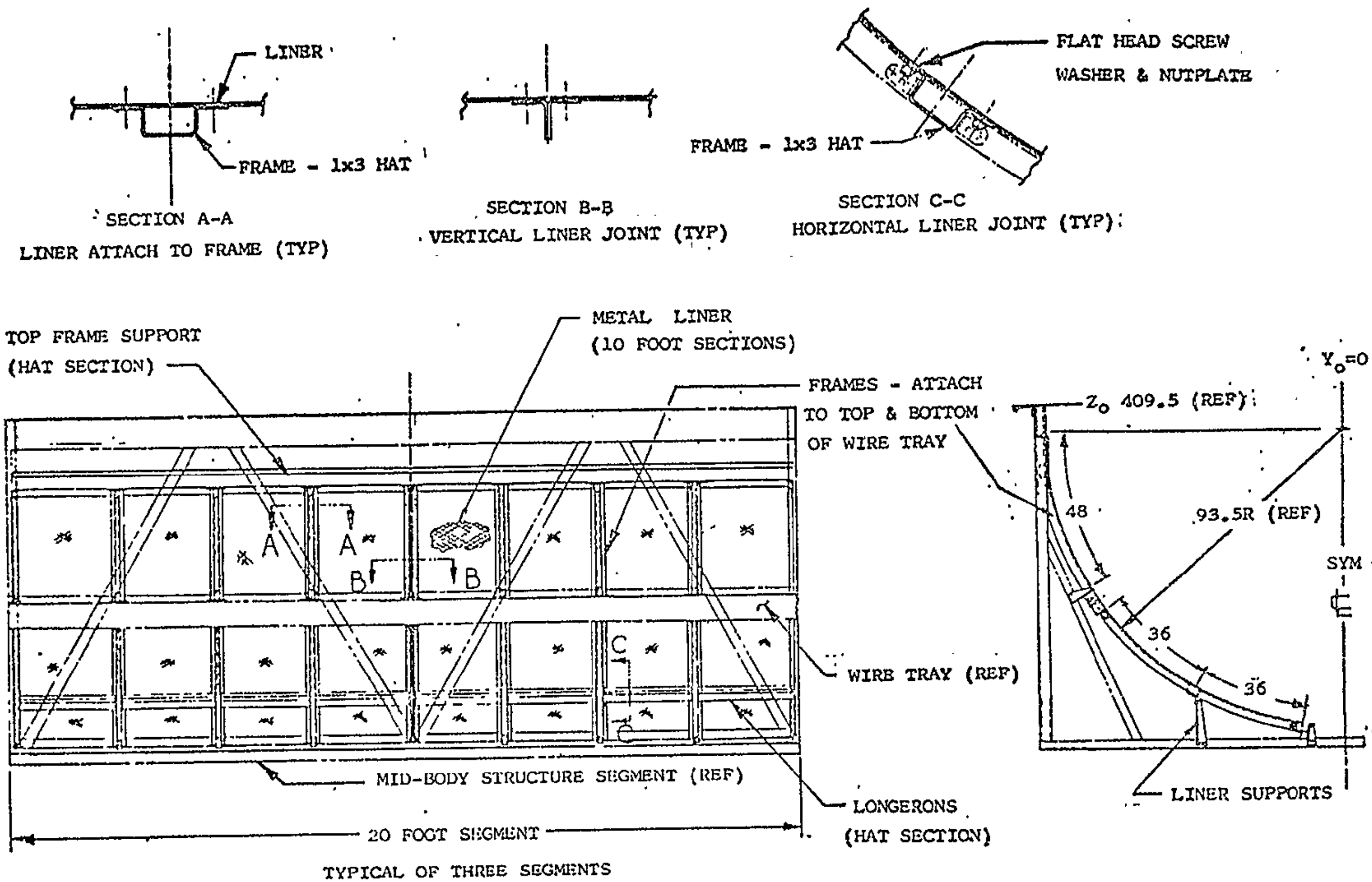

Figure 10-10. PAYLOAD BAY LINER

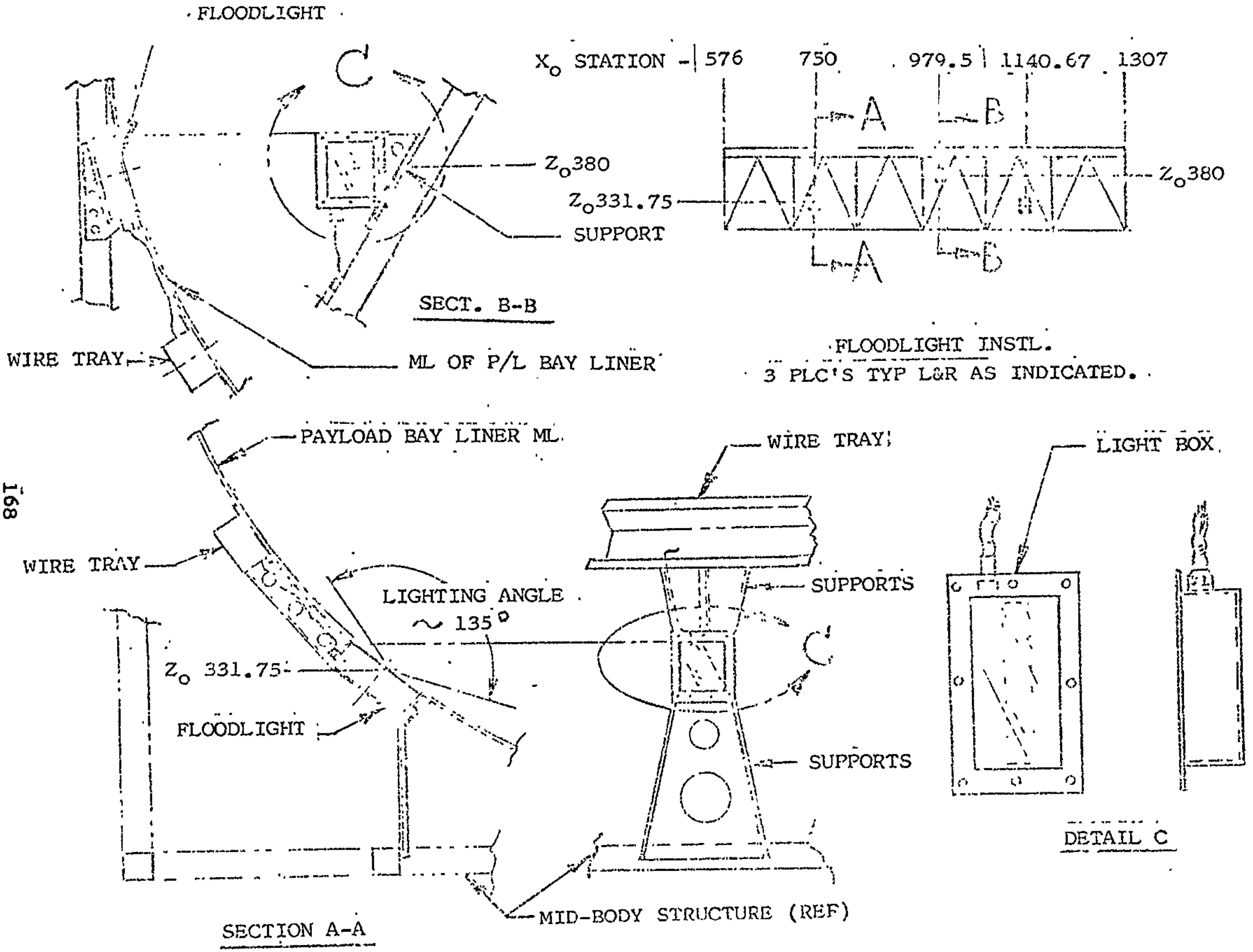

Figure 10-11. PAYLOAD BAY FLOODLIGHT

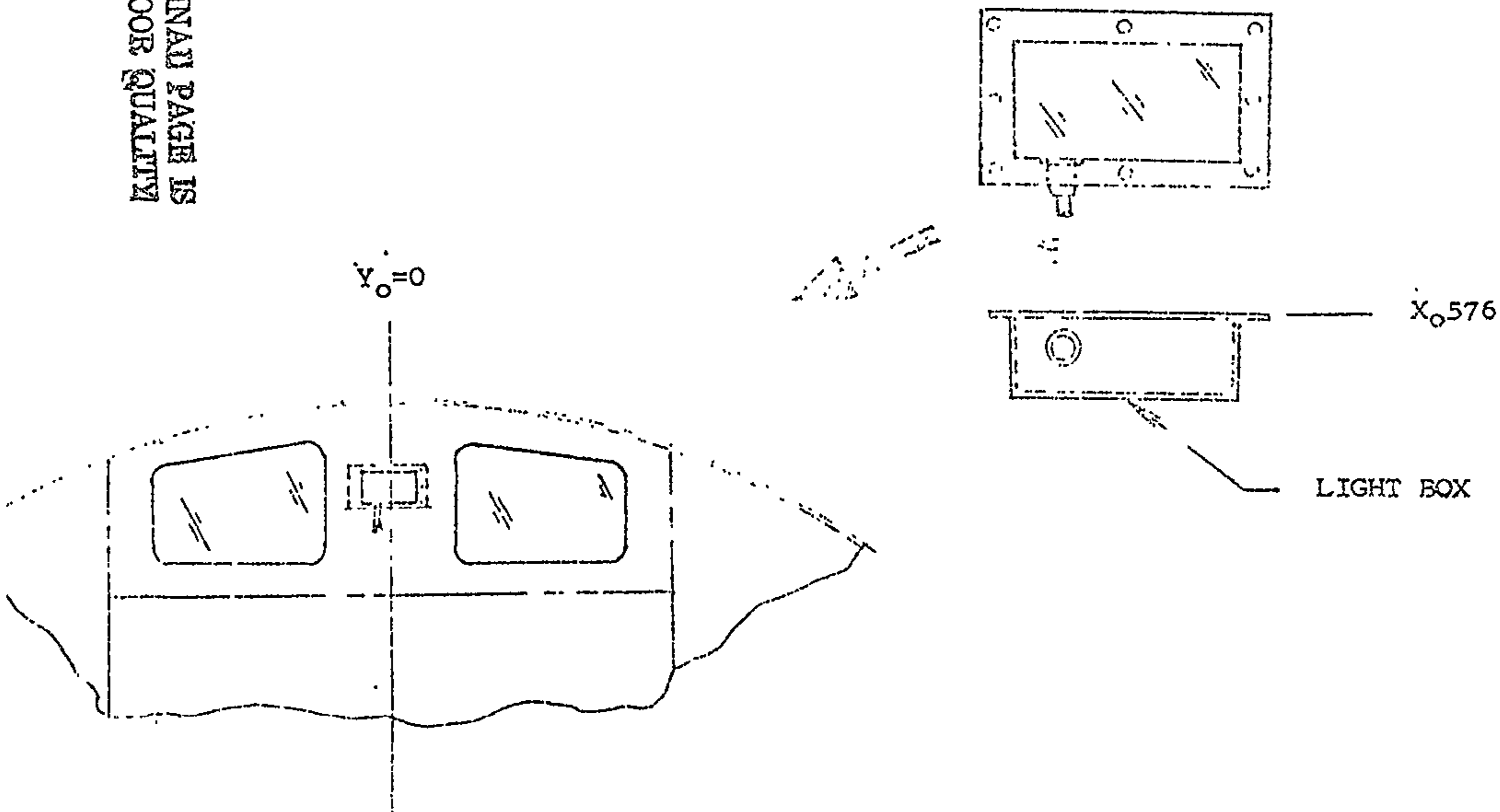

Figure 10-12. FLOODLIGHT - X_o 576 BULKHEAD

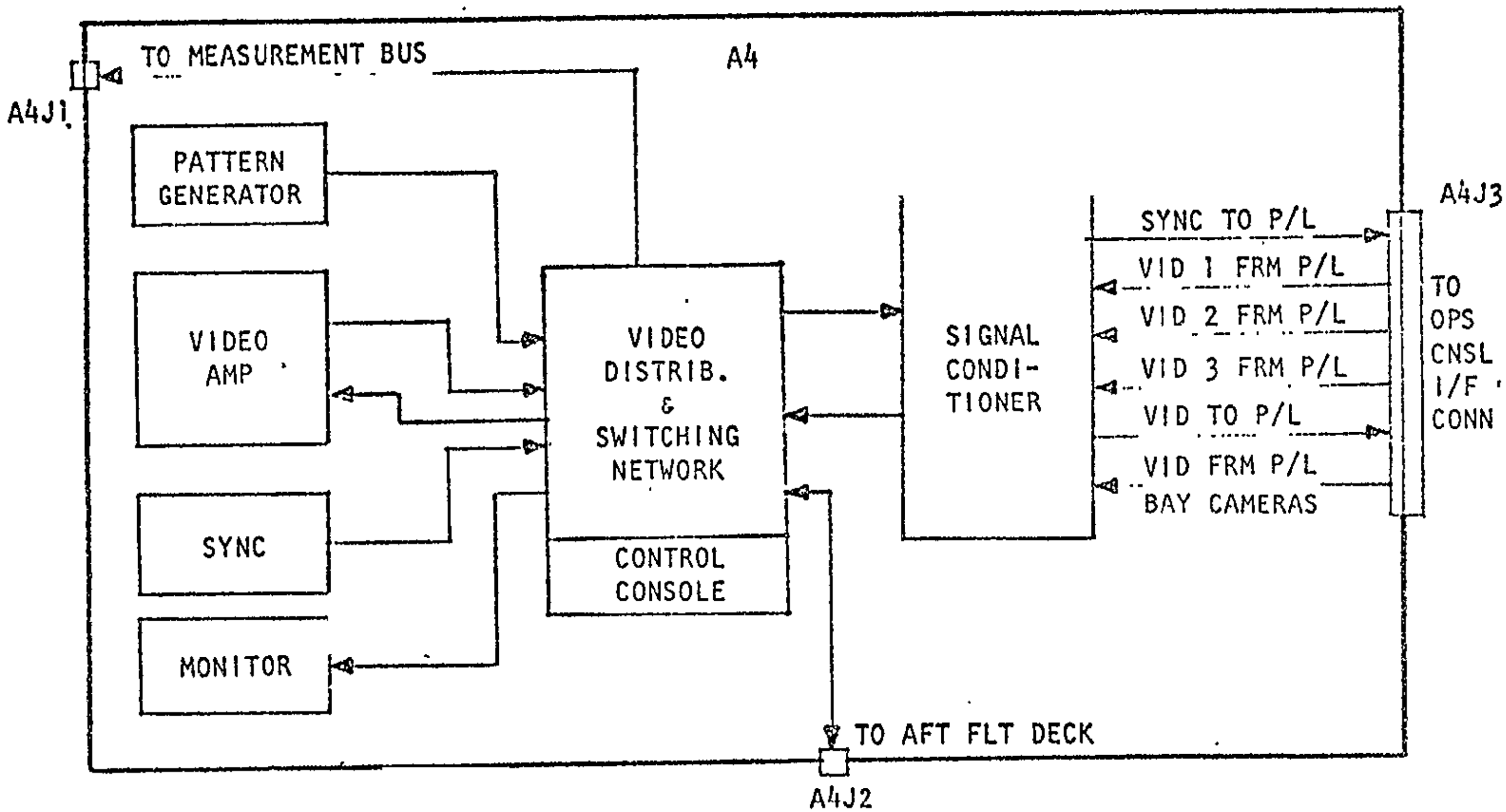

Figure 10-13. A4 - CCTV SWITCHING NETWORK INTERFACE BLOCK DIAGRAM

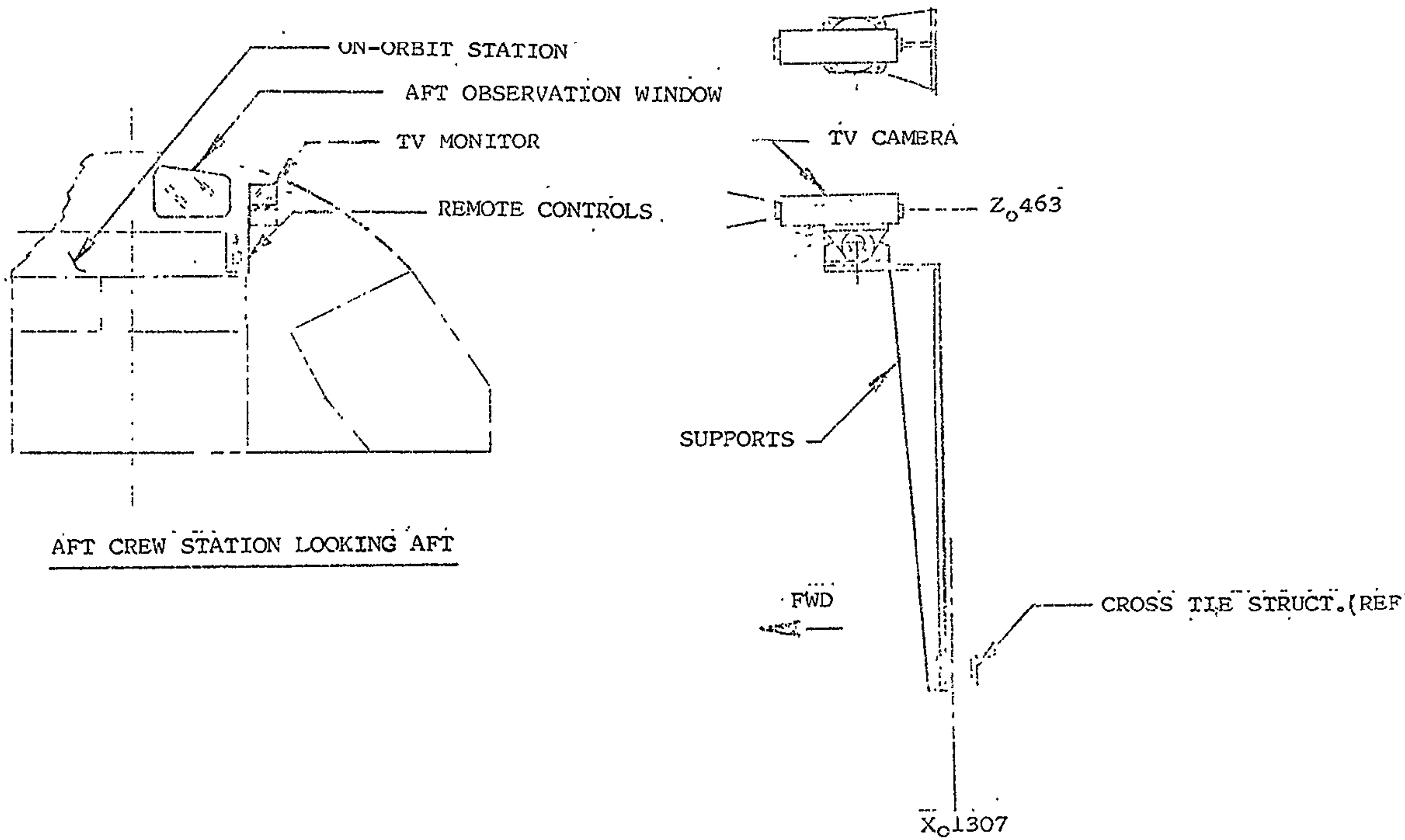

Figure 10-14. TV-X_o 1307

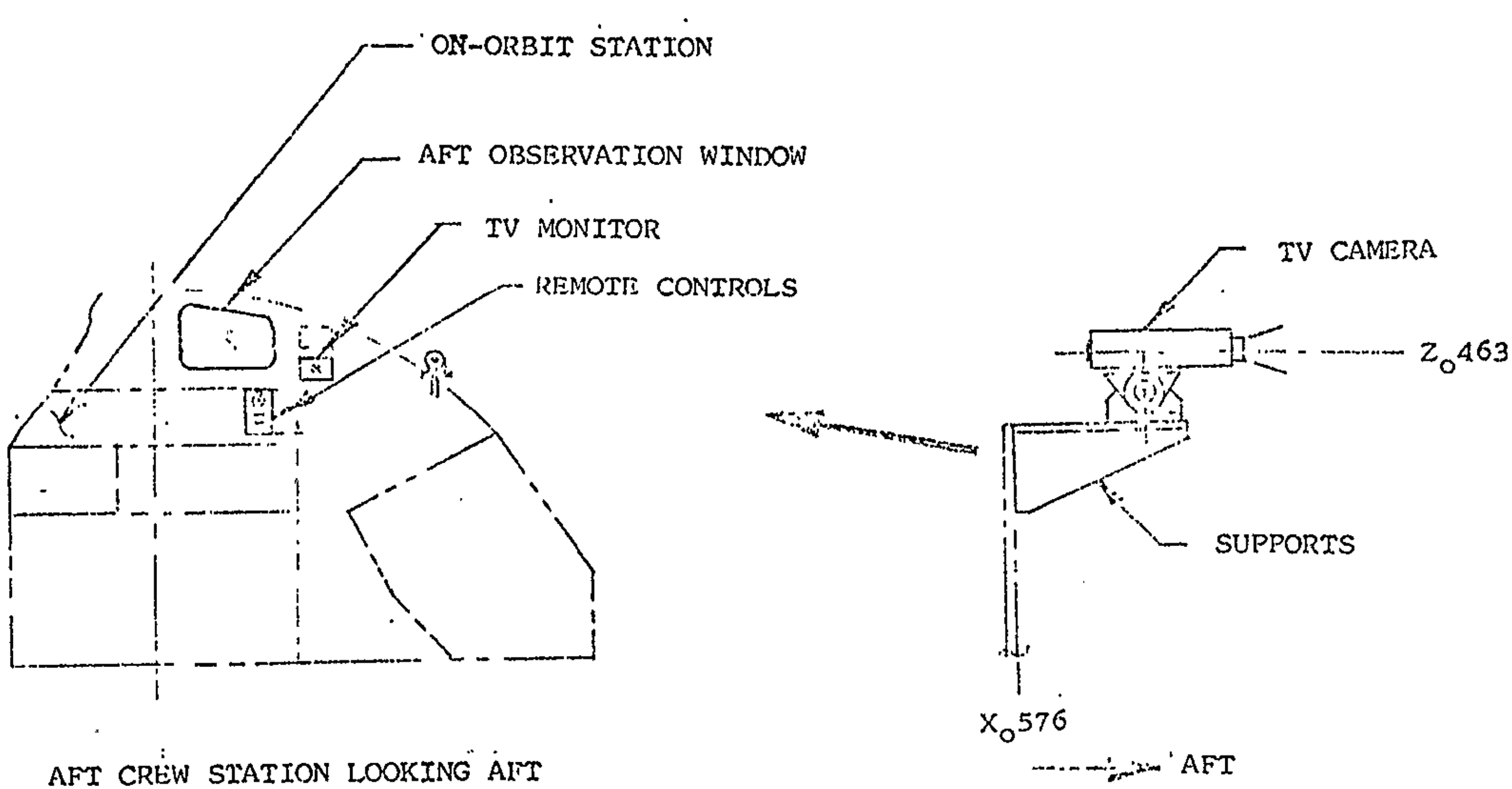

Figure 10-15. TV - X_o 576

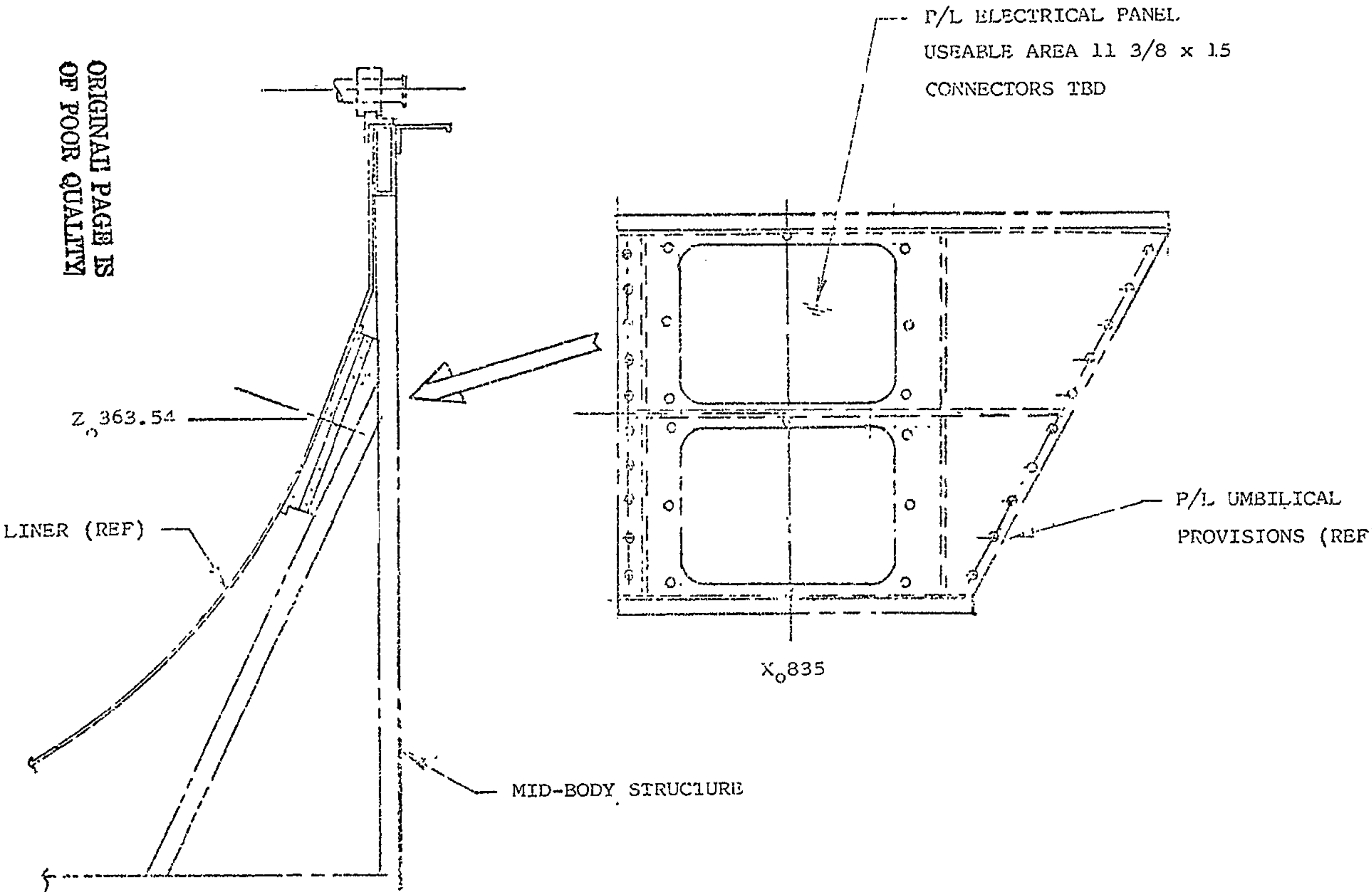

Figure 10-16. PREFLIGHT UMBILICAL ELECTRICAL PANEL

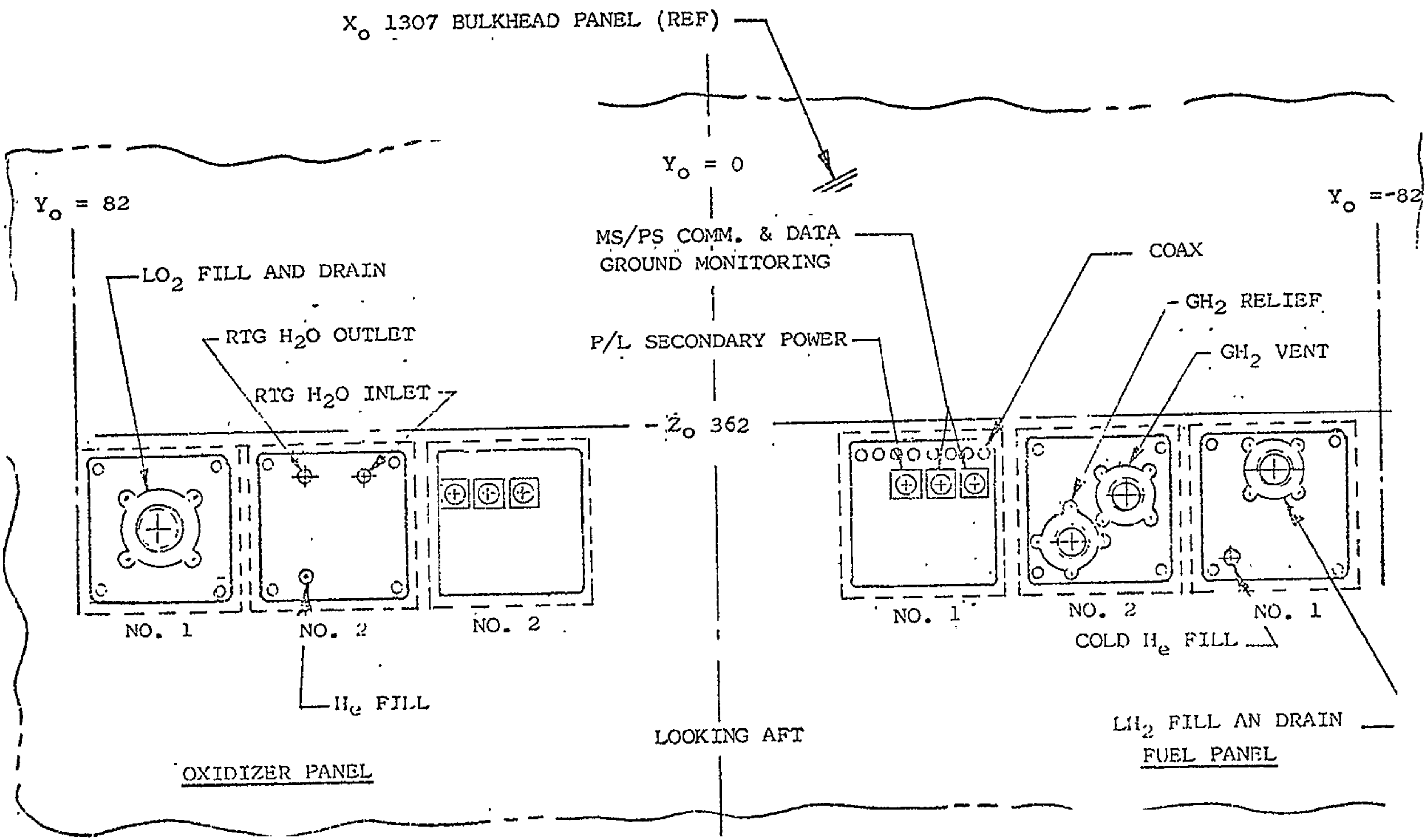

Figure 10-17. X$_o$ 1307 ELECTRICAL SERVICES

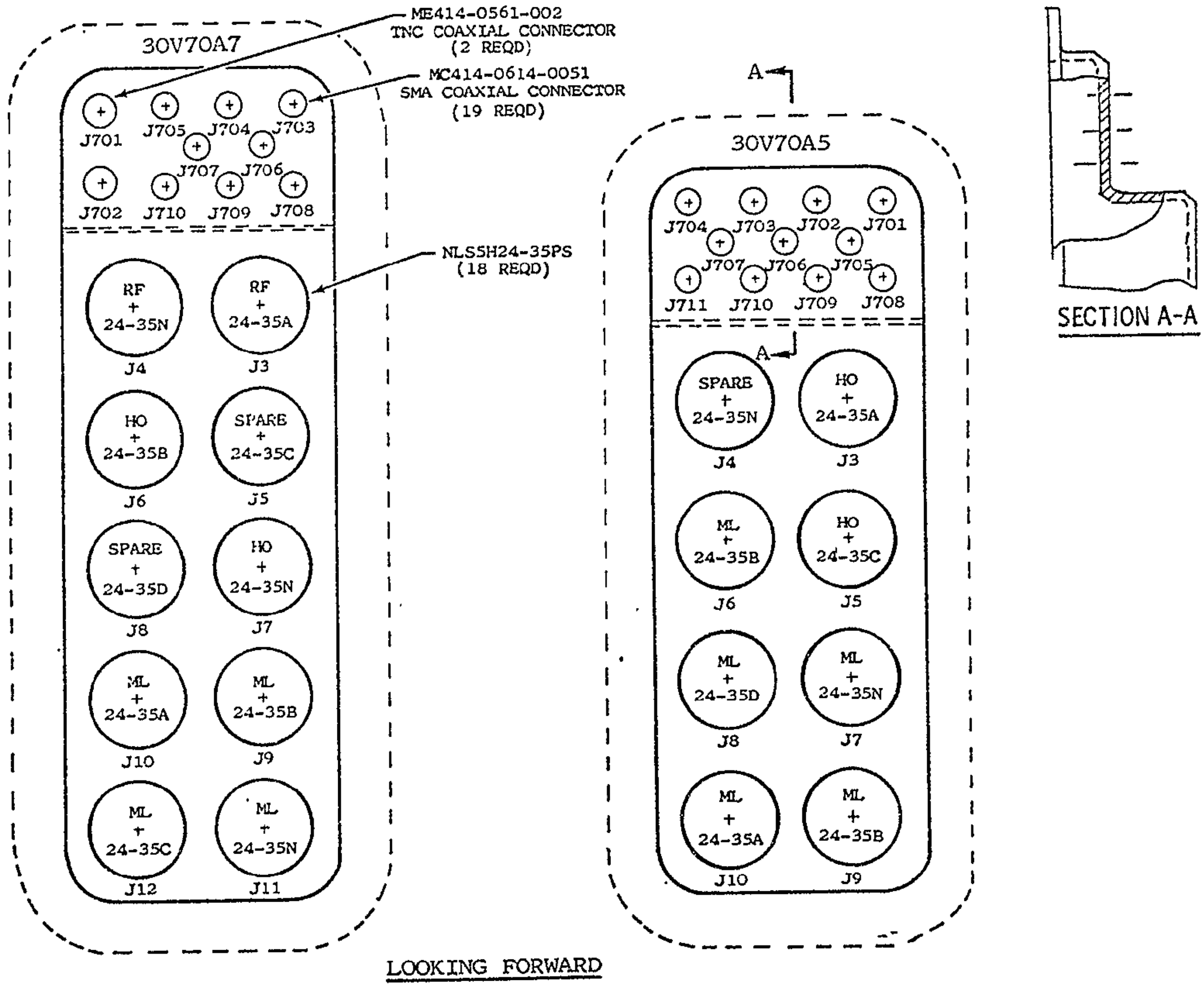

Figure 10-18 - X_o 576 PAYLOAD SERVICE PANEL ASSEMBLY

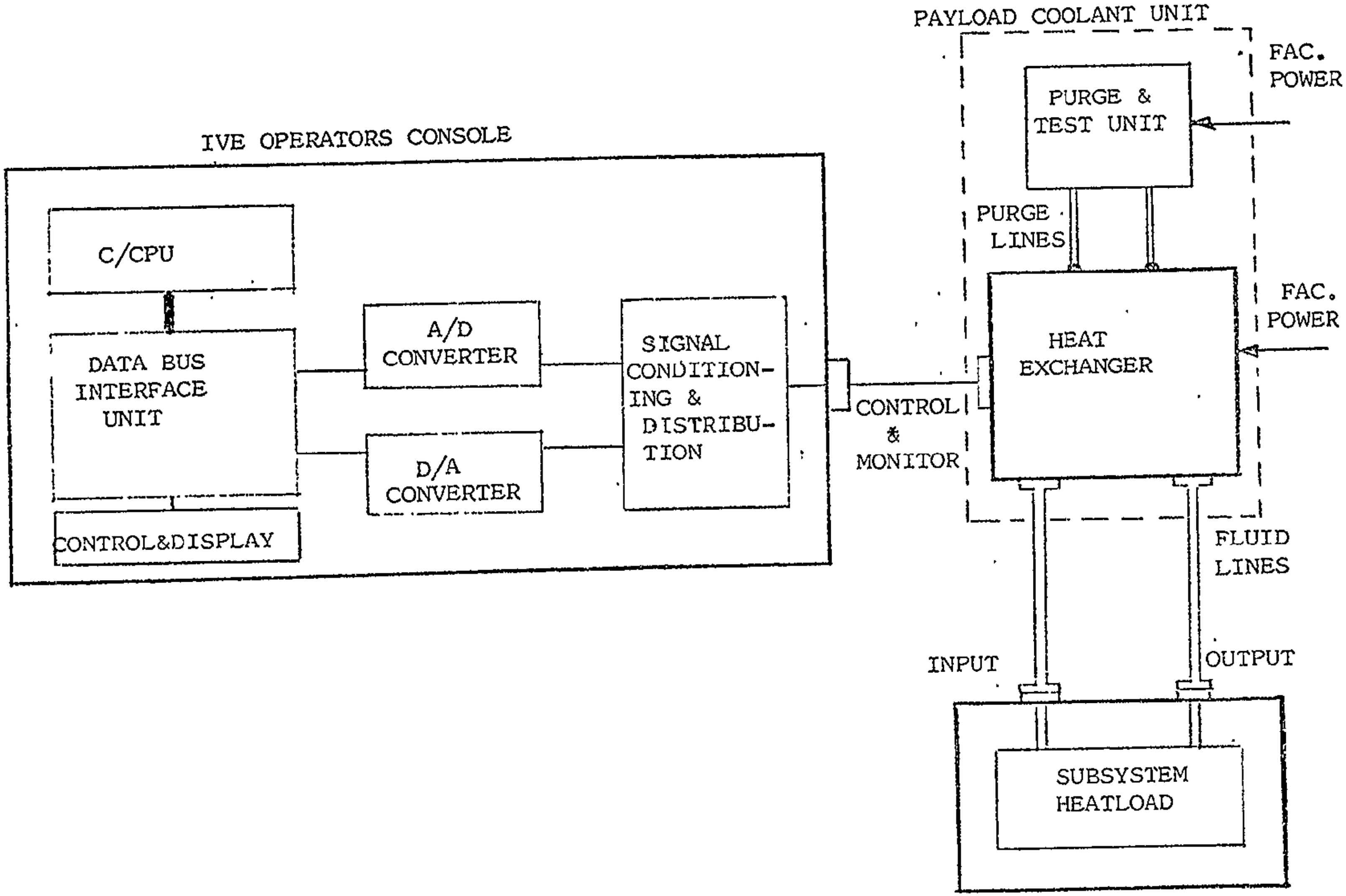

Figure 10-19. IVE PAYLOAD COOLANT UNIT - BLOCK DIAGRAM

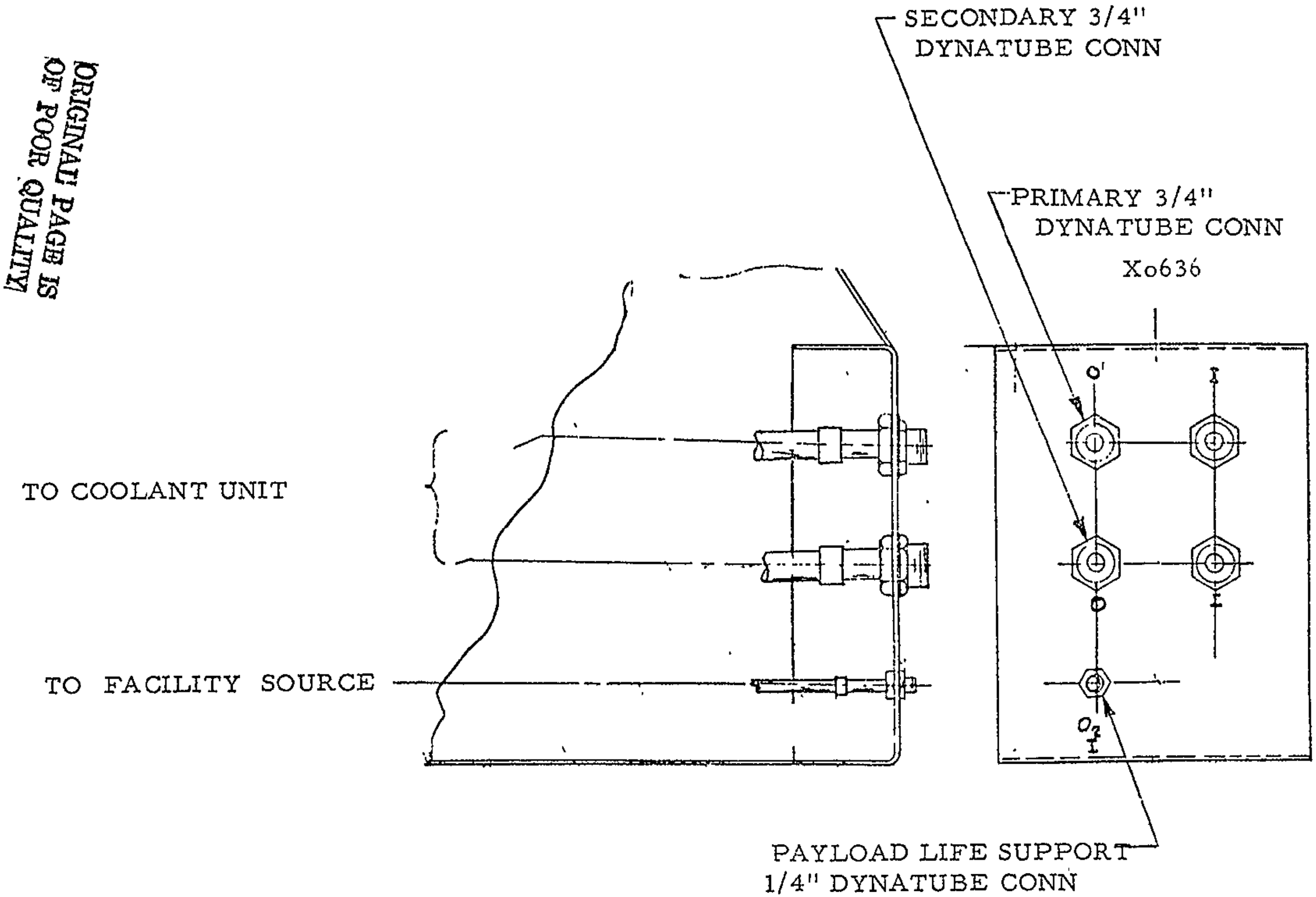

Figure 10-20. X_o 636 FLUID INTERFACE PANEL

C.3

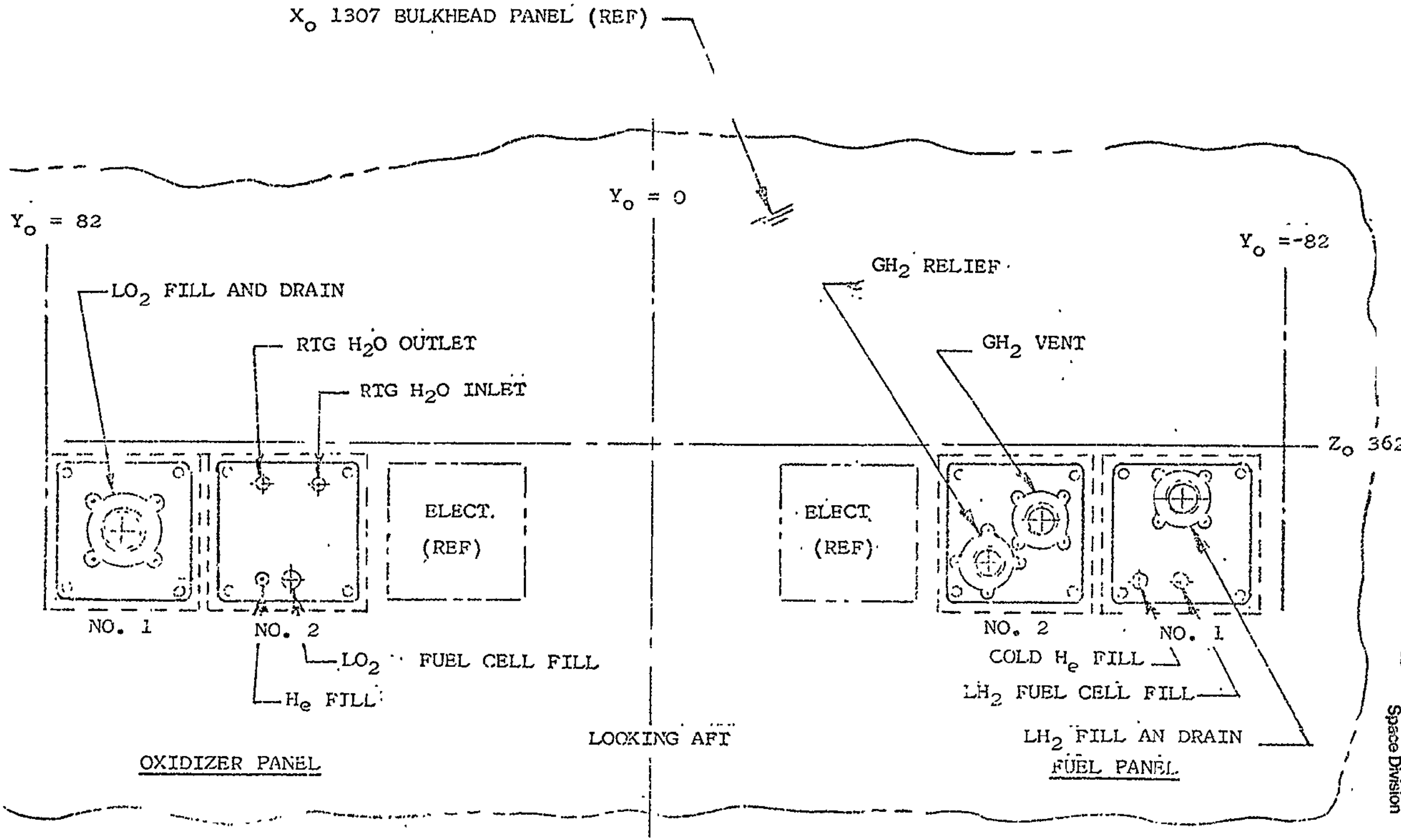

Figure 10-21. X_ 1307 PAYLOAD OXIDIZER AND FUEL PANEL

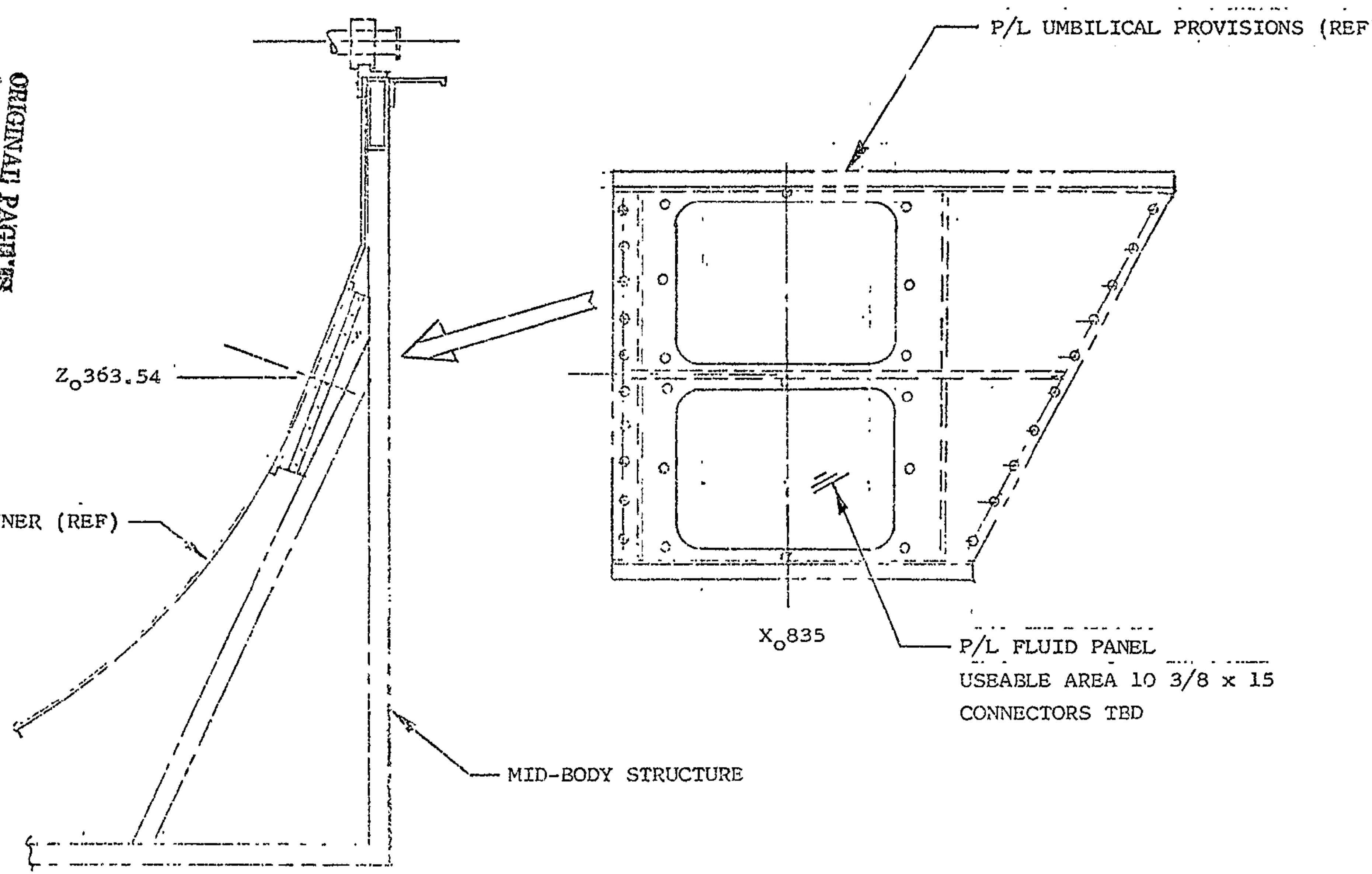

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Figure 10-22. PREFLIGHT UMBILICAL FLUID PANEL